ELECTRICAL REVIEW

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7 MAY 1954

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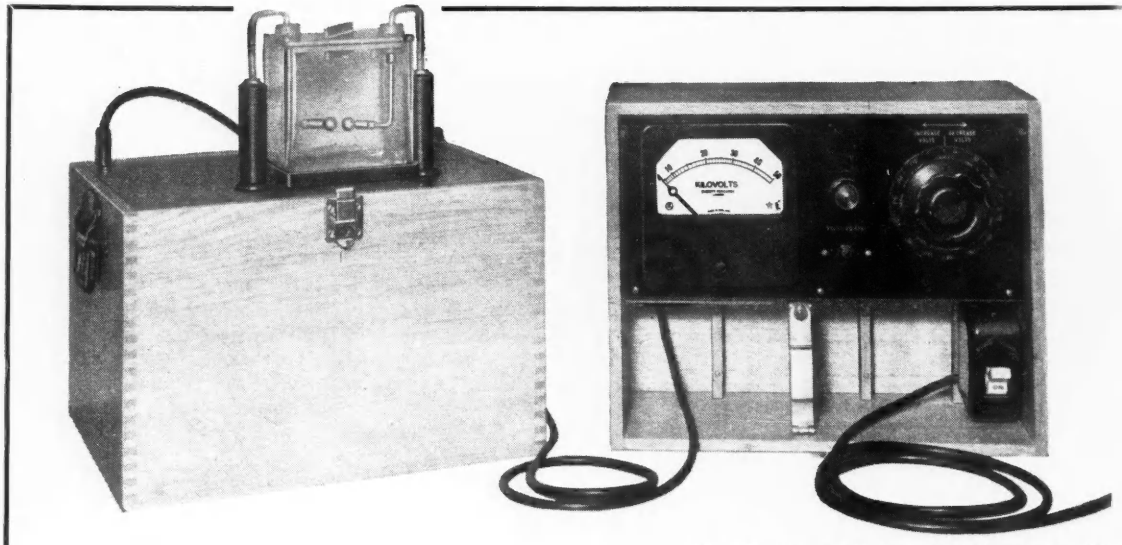

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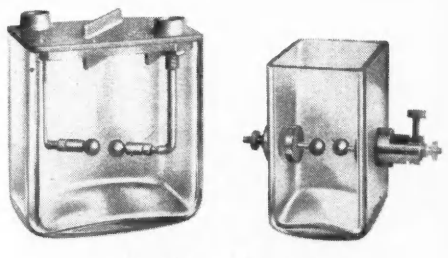

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ELECTRICAL REVIEW

7 May 1954 Vol. 154 No. 19 Established 1872

Fundamental Service

THE annual report of the British Electrical & Allied Industries Research Association for 1953 possesses intense interest, and it should be in the hands of every responsible member of the industries represented by the Association; it is a well written story of what is going on behind the scenes, mainly of the electrical industry. In common with practically all research work, that of the Association is largely hidden by its own manifestations in the form of commercial and utilitarian plant and equipment of one sort or another, and in saying this we have in mind particularly the magnificent work done in past years by the Association in connection with arcing control in circuit breakers. In this latest report, for instance, it is stated that " developments during the year in the dissociation theory of transitions in discharge channels have led to further elucidation of the conditions under which concentration of the arc column occurs, which bears intimately on the fundamentals of the mechanism of arc interruption."

Our interest in the report is quickened this year because we read it immediately after seeing demonstrations at the Association's Perivale laboratories of the first completed major section of the supply network analyser which is described separately in this issue—an excellent example both of engineering and of scientific instrumentation. We regard the work of the Association as one of the outstanding examples of co-operation, not merely with the electricity supply and manufacturing industries as is rightly stressed by Mr. C. T. Melling in his foreword, but also with such organizations as the Institution of Electrical Engineers, the National Physical Laboratory and the British Iron & Steel Research Association, and with the universities. Examples of the last-mentioned are the work which is in progress at the Clarendon Laboratory, Oxford, on the study of cathode mechanisms of discharge, and the measurement of magnetic hysteresis losses at high flux densities in a range of silicon iron sheet materials under the direction of Professor Brailsford at University College, London. Then, of course, there is the assistance rendered to many persons in and sections of the industries concerned in the translations made by the Association.

In connection with all the above, and much more represented by it, we congratulate the president, Sir John Hacking, the chairman of the Council, Mr. C. T. Melling, and his colleagues on the Council, Dr. S. Whitehead, the director, Mr. R. A. McMahon, secretary, and all members of the staff on work well done. We offer also our best wishes for the success of the Association's new home where we can see no end to its expanding work and guidance for those whom it serves, who are by no means merely its members. Finally, because research work is inevitably so expensive, it is pleasing to learn of the favourable response to last year's request for an increase in contributions. Despite the heavy demands on its resources, particularly in connection with the Leatherhead project, we believe that the financial future of the Association will be ensured by the value of its work.

LONDON TRANSPORT POLICY

Determined to proceed with its policy of abandoning electric road traction in favour of oil-engined buses, London Transport has announced its intention of getting rid of most of its trolley-buses, starting in about three years' time. Although a new type of oil-driven bus is being introduced, with a carrying capacity not far below that of the trolley-bus, we still doubt whether the conversion will be an improvement. London Transport says that the trolley-buses which are to be superseded are reaching the end of their useful lives, about 21 years. After this period maintenance would be heavy and uneconomic. Nothing is said about the life of the new oil-engined buses but experience has shown that trolley-buses not only last considerably longer but " stay young " longer. Running costs, it is said, will be virtually the same; this conflicts with the evidence of other transport authorities with mixed systems, but conditions in inner London are no doubt peculiar. In the statement there is absolutely no recognition of the undoubted merits of the trolley-bus which, however, are appreciated by passengers. Seven routes in the south-western suburbs are being retained, not, apparently, because they give such a satisfactory service to the public but because it suits London Transport to keep them going.

COMPETITION BARRED

Dunfermline is probably unique in having a Baths Electrical Department and it is not to be wondered at that this establishment cannot find enough to do in its own field. This has been attended to in a recent resolution passed by the Town Council which is handing over to it all installation work in Corporation property, including housing schemes and public lighting. There is a proviso that the work shall be within the " competency and capacity " of the Department and in this matter the Baths Superintendent is to be the judge, subject to the concurrence of the burgh architect or engineer. The most interesting feature of the decision is that the practice of inviting tenders by public notice is to be " superseded," except where a Government Department is financially interested and asks that this procedure shall be followed. At the meeting at which the resolution was passed one councillor said that the Department had already shown that it could quote the lowest price and yet do a worthwhile job and another said that the cheapest job was not the best job. The exclusion of competition will deprive the ratepayers of any standard by which they can judge whether they are getting their money's worth and is to be strongly deprecated for this as well as for other obvious reasons.

HOUSING IMPROVEMENTS

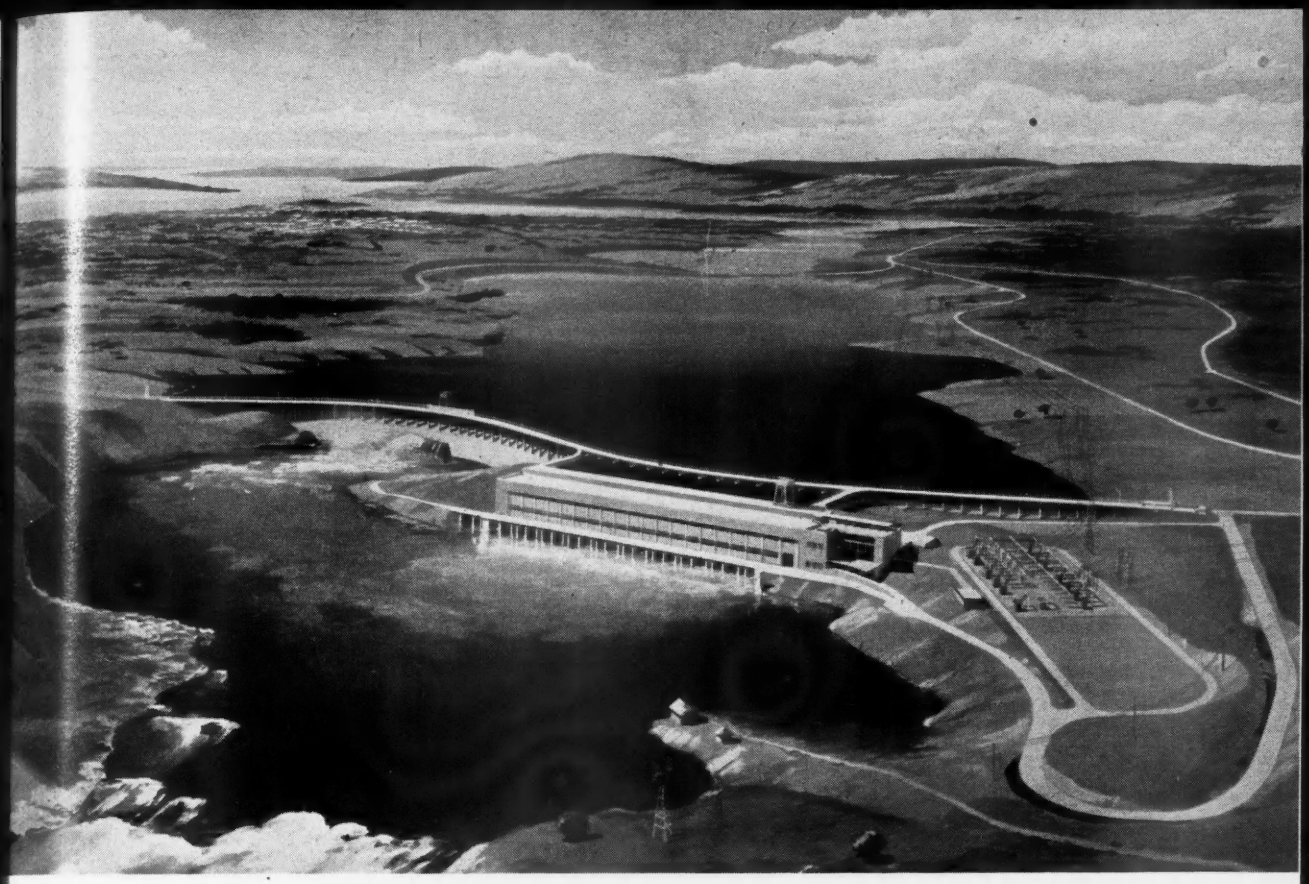
Opportunities for electrical contractors will arise from the operation of the Housing Repairs and Rents Bill now before Parliament. Already, under the 1949 Housing Act, local authorities are authorized to make grants towards the cost of the improvement and conversion of houses; the new Bill seeks to encourage applications for grants and relaxes the conditions under which they may be made. In a circular to housing authorities the Minister of Housing and Local Government calls attention to the revised provisions which were drawn up after consultation by the Minister with interested representative bodies. The circular sets out twelve requirements which have to be satisfied by applicants for grants. Among other points it is stipulated that a dwelling after improvement or conversion must be provided with efficient and adequate means of supplying hot water; with adequate points for gas or electric lighting (where reasonably available); with adequate facilities for heating; and with satisfactory facilities for storing, preparing and cooking food. It is clear that this gives quite good scope for electrical work and those concerned should watch the agendas of their local councils for particulars of applications for grants from property owners. They might even suggest improvement schemes to property owners, drawing attention to the possibility of grants. The lower limit to the cost of schemes for which grants are sought has been reduced to £100; there is no upper limit, but normally grants will not exceed £400.

FAVOURABLE FACTORS

One important feature of the Owen Falls hydro-electric scheme which is described in this issue is the comparatively low capital cost of the dam, power house, generating plant and all the auxiliaries. The cost of about £80 per kW is roughly comparable with the corresponding cost of steam stations recently built or under construction, and is considerably lower than figures for a good many hydro-electric stations. The major reason for this lies, no doubt, in the favourable geographical position of the main reservoir. In the greatly elevated Lake Victoria there was a natural storage already in existence for the electrical requirements, so that the dam across the Nile serves mainly for regulating the water flow to the turbines and the by-pass rather than for creating storage, although the storage has been increased so as further to improve irrigation of the countries northwards through which the Nile flows. Contributory to this major cause is the absence of large-scale tunnelling and diversions throughout the watershed.

POWER SUPPLY FORECASTING

Forecasting the performance of a large power system such as, for example, the present British grid without some form of analysing equipment savours too much of trial and error in these days when wide ramifications demand a closely accurate knowledge of the behaviour of the system under many different conditions. It was therefore good to see at first hand the progress that has been made in the development of the analyser, described elsewhere in this issue, by the British Electrical and Allied Industries Research Association at Perivale. To represent all the components of a major power system in a working model with electrical values accurately scaled to give reliable computation is no small achievement.



Owen Falls Hydro-Electric Scheme

UTILIZING THE WORLD'S THIRD LARGEST NATURAL RESERVOIR

THE Owen Falls hydro-electric scheme in Uganda, which was officially inaugurated last week by Her Majesty the Queen during the final stages of her world tour, has aroused great interest since 1948 when this important development to harness the resources of the Victoria Nile, and so extend the supply of electricity in Uganda, was started. For many years engineers had been giving considerable thought to the potentialities of the Nile as a form of hydro-electric power, and as long as 45 years ago Sir Winston Churchill wrote of the Owen Falls in his book "My African Journey":

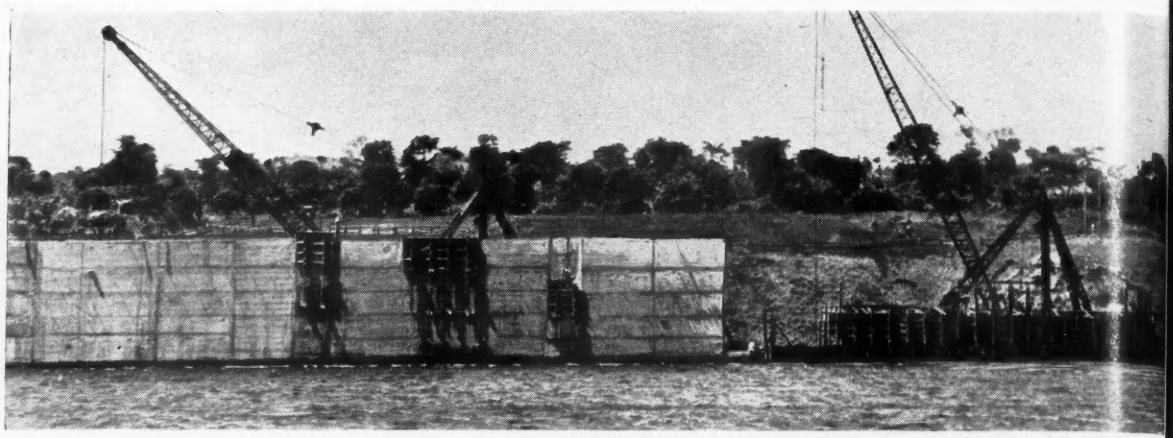
> "So much power running to waste, such a coign of vantage unoccupied, such a lever to control the natural forces of Africa ungripped, cannot but vex and stimulate imagination. And what fun to make the immemorial Nile begin its journey by diving through a turbine!"

The complete scheme will cost over £12 million, excluding transmission, for 150 MW of plant capacity which, it is expected, will be mainly used in Uganda itself by textile and steel industries, in the production of electrolytic copper and, of course, in meeting general industrial, municipal and domestic requirements. To facilitate the construction of the dam and associated buildings a new cement industry was set up, about 80 miles from Owen Falls, and this will ultimately produce about 60,000 tons of cement annually.

The Owen Falls are situated near the town of Jinja, on the north shore of Lake Victoria, a vast natural reservoir situated 3,700ft above sea level, which is about 250 miles long by 150 miles wide and has an area of 26,800 sq miles —almost the size of Scotland—and a storage capacity of 7·3 million million cu ft. It is here that the River Nile starts on its 3,500 mile course northwards to the Mediterranean. The river leaves Lake Victoria at its north end and, pouring over the beautiful Ripon Falls, proceeds through Lake Kioga in a north-westerly direction until it reaches the north end of Lake Albert.

This 260 mile section of the river is known as the Victoria Nile, and below Foweira, for a distance of about 50 miles, is impeded by a series of rapids culminating in the Murchison Falls where the river drops 150ft in three cascades to the level of Lake Albert. The whole pent-up waters of the Victoria Nile, which abounds with crocodiles and hippopotami, pass through a 20ft wide gully in the rock. It was in 1862 that Speke, an Englishman, discovered the Ripon Falls and found that the Nile began its course with a waterfall in a part of Africa which until then was entirely unexplored. The Owen Falls are quite near the Ripon Falls and in the first 40 miles of its journey the Nile passes over a number of such falls and drops several hundred feet.

Our title picture is from an artist's impression of the Owen Falls dam and power station which are situated where the waters of Lake Victoria discharge into the Nile



The main dam is of the mass concrete gravity ty

The road and railway cross the Nile a short distance below the Ripon Falls. The bridge is a two-deck structure carrying the railway above and a roadway 34ft below. The lower deck of the bridge will be awash as the result of the erection of the Owen Falls dam, and has been replaced by a public road which is carried on the main dam, crossing the intake channel by means of a bridge upstream of the turbine intakes. The next bridge downstream over the Nile is at Kosti, a distance of 1,300 miles north.

The damming of the Nile at Lake Victoria offered an exceptional opportunity for controlling the headwaters of the Nile by providing an immense reservoir. The countries through which the river passes on its long journey to the sea have a vital interest in any scheme affecting the flow of the Nile waters, as their agricultural economy is largely based upon the use of the river for irrigation purposes. The importance of the Nile to Egypt and the Sudan cannot be overestimated; its annual inundations fertilize the soil and it provides the water vitally necessary for irrigation without which the whole country would be a desert.

Now the Nile is being dammed at Jinja where it leaves Lake Victoria, thus permitting the raising of the level of this vast sheet of water (the third largest lake in the world) by 3ft, providing Egypt and the Sudan with a permanent regulated reservoir of water, and Uganda with tens of thousands of kilowatts of power for developing new industries. The damming of the Nile has meant that in a comparatively short period after their discovery the Ripon Falls have given way to a great feat of engineering.

The watershed of the Owen Falls hydro-electric scheme is the environs of Lake Victoria which has a natural storage of 7·3 million million cu ft

The main dam which blocks the river just downstream of the Owen Falls has been built in two stages within cofferdams. In the first stage, the river flow was confined to the part of the channel which remained after the construction of the first cofferdam. During the second stage the water passed through temporary openings left in the construction of the dam built in the first stage. The intake dam, which lies immediately behind the power house, is about 580ft long.

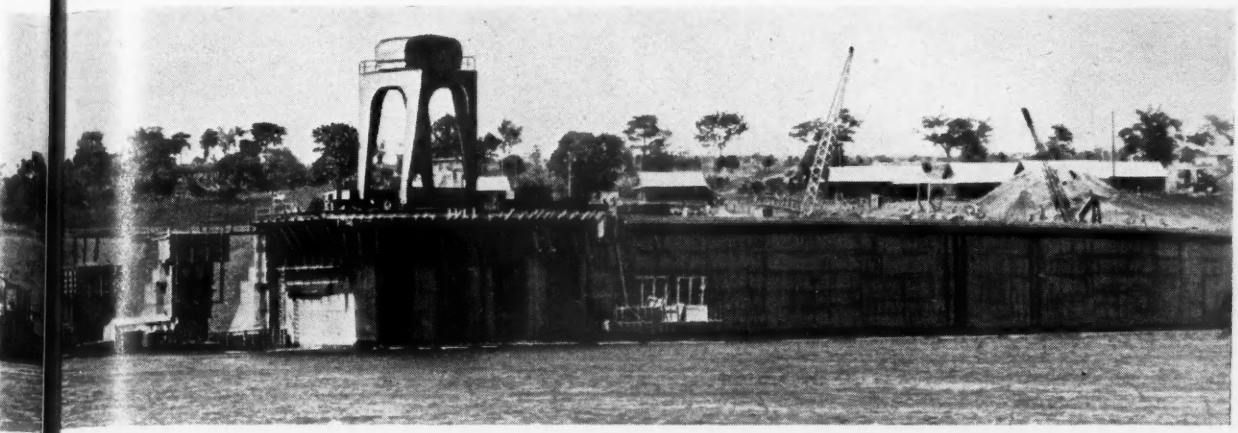
A gravity dam in cyclopean concrete 2,500ft long forms the main barrier across the river bed and this dam is designed with a slight curve against the pressure of the water and has a maximum height of 100ft above the foundations. Six low-level ground sluices are provided in the centre of the dam, each 16ft 9in high and 9ft 10in wide, designed to pass the maximum flow of the Nile or about 45,000 cusecs. A concrete bucket with a slope of 45 deg at the outlet of these sluices dissipates the energy of the water and prevents the possibility of scour along the back of the dam.

The River Nile flows through a restricted channel at Owen Falls caused by a rocky spur jutting out from the west bank. The power house is situated on the downstream side of this spur which enables the foundations to be constructed with a cofferdam on the downstream side only. A saddle in the centre of the spur is below the future water level and requires only a small amount of excavation to provide a headrace for water passage to the turbines. This headrace is crossed by a road bridge continued along the top of the dam which will replace the existing roadway suspended under the Nile railway bridge about a mile upstream.

The Nile thus now begins its journey by diving through turbines situated at Owen Falls. This hydro-electric scheme will be the first to generate power on such a scale in Central Africa. Indeed, it is claimed to be larger than any other hydro-electric scheme in Africa south of the Sahara. The generating plant so far ordered consists of six 15 MW turbo-alternators; ultimately ten sets will be installed.

The intake to each turbine can be closed by means of a 21ft by 23ft free roller intake gate designed to operate under unbalanced hydraulic conditions. The gate is counterbalanced and driven by an electric motor through gearing.

Upstream of the intake and control gate each intake is divided into two halves separated by a splitter wall about



and is about 2,500ft long and up to 100ft high

18ft 6in long. Guides are provided in this section for screens fitted with trash retaining bars to prevent debris entering and damaging the turbine runners. Equipment is provided to show the head loss across the screens, thereby indicating when they need cleaning, for which purpose they are lifted to the top of the intake dam by a motor driven 30 ton travelling Goliath crane. Bulkhead gates are provided for use in the screen slots when maintenance work on the control gate is necessary. The bulkhead gates are not designed for raising or lowering under unbalanced pressure conditions and by-pass piping has been provided in the concrete of the dam to equalize the pressure on both sides of these gates. The intake gate equipment has been supplied by Glenfield & Kennedy, Ltd., and the 30 ton crane by Sir William Arrol & Co., Ltd.

The water turbines were designed by Boving & Co., Ltd., and are of the Kaplan vertical shaft type, developing 21,000 h.p. under a net head of 62ft; the normal speed is 150 r.p.m. The pitch of the five turbine runner blades is varied by an oil operated servomotor in the runner hub, the servomotor regulating valve being controlled by a rod which passes down through the centre of the turbine and alternator shafts from the combinator mounted above the main exciter. The combinator is connected by a link mechanism to the governor actuator (which also controls the guide vanes through a separate servomotor and the regulating ring and associated levers and links), and in this way the runner blades are adjusted automatically to the most efficient position at any gate opening.

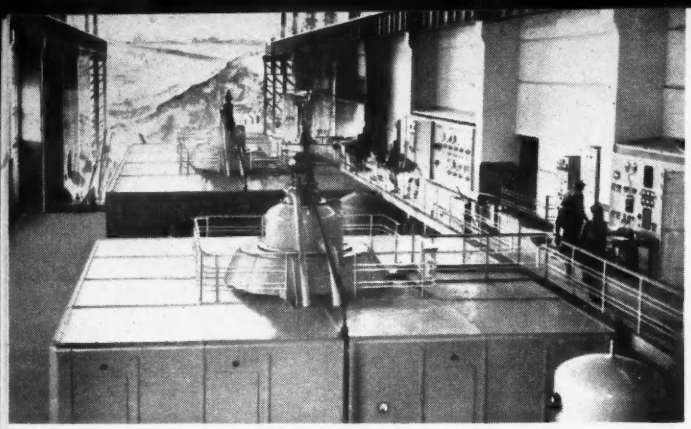
The turbine spiral casings are of fabricated plate steel construction, welded together on site, and each has an inlet diameter of 21ft. The diameter over the turbine runner blades is 13ft.

The water " consumption " of each turbine at full load is equivalent to just over 1,830 million gallons every 24 hours—over twice the normal summer flow of the Thames at Teddington Weir. As the generating sets may be called upon to operate as synchronous condensers, arrangements have been made to depress the water level in the turbine runner chamber by admitting compressed air to the top cover. The water is thus " pushed " down clear of the runner, which can then rotate in air and avoid the losses associated with turning in water.

The oil pumping sets for each turbine governor may be interconnected by means of bus pipes in the event of break-down or overhaul of any of the pumping sets. Tappings

The various parts of the Owen Falls hydro-electric scheme, indicated in this illustration prepared from a model, are clustered where a spur of rock juts out from the western bank in a restricted channel of the Nile

(1) Lake Victoria 26,000 sq miles in extent. (2) Road to Jinja. (3) Gravity dam 2,500 ft long, 100ft high, 223,000 cu yd of concrete. (4) Control tower for sluices. (5) Six sluice gates each 9ft 10in wide by 16ft 9in high, maximum flow of water 45,000 cusecs. (6) Roadway over dam and headrace. (7) Power station: ultimate capacity ten turbo-alternators of 15 MW each, head of water 57·5ft to 72·5ft, maximum flow through each turbine 3,600 cusecs, length of building 585ft. (8) Headrace. (9) Tailrace. (10) Intake dam. (11) Two 33 kV lines to Jinja. (12) Road to Kampala. (13) Road to power station. (14) Two 66 kV lines to Kampala. (15) The main substation. (16) River Nile maximum recorded flow 43,000 cusecs



The first two 15 MW turbo-alternators which were inaugurated last week by H.M. Queen Elizabeth

from each spiral casing feed a water bus main which will run the full length of the station for supplying the alternator air coolers and the unit and station auxiliaries. This main also supplies a 35 h.p. horizontal shaft Francis turbine driving a stand-by governor oil pump, which can supply pressure oil to any of the turbine governors in the event of a power failure.

The B.T.H. alternators are each rated at 16,700 kVA, 150 r.p.m., and generate at 11 kV. They are of the vertical shaft " umbrella " type each fitted with a combined thrust and guide bearing at the bottom only. There is no guide bearing at the top end of the shaft and the whole rotor, which weighs about 130 tons and has an outside diameter of about 19ft, thus spins on the bottom thrust bearing like a top. The rotor spider and poles may be likened to the canopy of an umbrella from which this type derives its name. The rotor spider carries forty field poles, each weighing 1,400 lb, on its periphery. In order to cater for the overspeed conditions associated with water turbines of this type, the construction of the spider and poles must be capable of withstanding a speed of 23,000 ft/minute on the pole tips.

The turbines, shown under construction, are of the Kaplan vertical shaft type and have a normal speed of 150 r.p.m.

In these machines the hot air discharged is passed through air coolers situated in the corners of the square stator casing, the cooling air being circulated continuously through the machine and coolers. This closed air circuit ensures that the ventilating air is always clean and heaters are fitted inside the frame so that during idle periods the air temperature within the machine can be kept higher than the surrounding atmosphere to prevent condensation. The stator frame has a diameter of 25·5ft and the wound stator weighs about 55 tons. The stator and the coolers are enclosed within a casing measuring 28ft square.

In order to overcome difficulties in transporting the plant to site in Uganda the stator was constructed in four sections, each having a packed weight of about 17 tons. The rotor can be dismantled and the shaft, spider, poles, and rim packed independently and shipped separately. Similarly, the top and bottom supporting brackets have detachable arms to facilitate transportation.

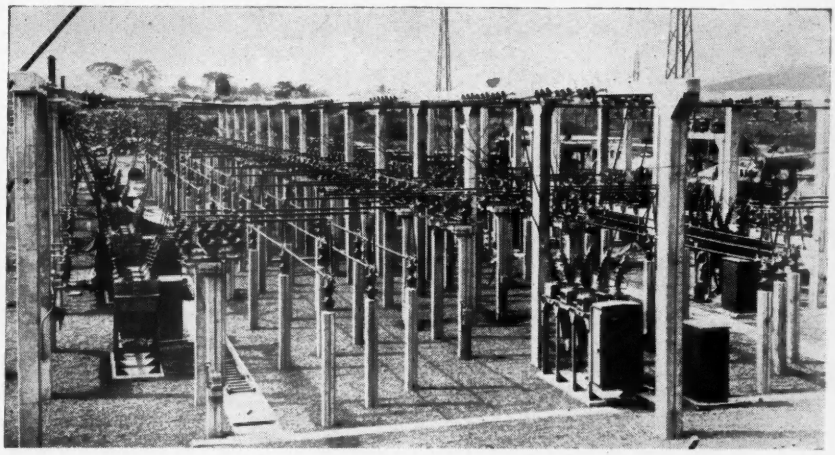
The excitation system for each alternator consists of a main exciter mounted on an extension of the main shaft and a separately driven booster exciter set. This arrangement has several advantages, including a reduction in the overall height of the alternator set because of the removal of the pilot exciter usually mounted on the main shaft. The booster set carries an amplidyne generator which, in conjunction with an electronic type voltage regulator, ensures stability and rapid response to load variations. Sliprings on the main exciter provide a.c. power for the small synchronous motor driving the pendulum on the turbine governor.

Each generator is directly connected to a 16,670 kVA 11/33 kV 0·9 power factor delta/star connected outdoor oil-immersed water-cooled transformer. The four main generator transformers, which were manufactured by Bruce Peebles & Co., Ltd., are of the conventional core type, with vertical legs provided with transverse oil ducts. The 11 kV winding is the inner winding and is mounted on an insulating cylinder next to the core. This winding is separated from the 33 kV winding by an insulating cylinder and liberal oil ducts on each side. Spacers provide good oil circulation and high insulation strength between windings and to earth. The windings are formed of disc coils with interlocked spacers arranged in such a way that they are free to slide when the coils are being tightened, yet they cannot work loose in service.

The transformers are equipped with duplicate forced-oil coolers to provide 100 per cent stand-by facilities, one complete cooler with its totally submerged motor-driven oil pump being placed at each end of the transformer. Each pump is capable of dealing with the full load cooling requirements by forcing oil through the Serck cooler, which consists of a nest of small-bore tubes mounted in a jacket through which water is circulated to dissipate the heat from the oil. Bruce Peebles also have under construction for the scheme two additional 16,670 kVA 11/132 kV generator transformers.

The generator switching is done in an outdoor substation, alongside the power house, in which there are twelve frame-mounted 33 kV outdoor circuit breakers supplied by the General Electric Co., Ltd. Each has a rupturing capacity of 750 MVA at 33 kV and a full load current carrying rating of 800 A. Each breaker consists of three separate double-break, low oil content, single-phase units mounted in steel tanks, supported by a steel framework. With this form of construction the contacts

Switching for both generation and transmission is effected at the main outdoor transforming and switching substation adjacent to the power station



Sir Charles Westlake, M.I.E.E., Chairman of the Uganda Electricity Board

can be inspected without removing the oil from the tank or breaking oil-tight joints.

Of the 45 rotary isolators in the substation, also G.E.C. gear, 43 are for 33 kV and two for 66 kV operation. The rotating blade arms of the isolators are carried on pivoted insulator stacks mounted between two stationary stacks which support the fixed contacts. The three blade arms of a three-phase unit are interconnected by the operating rods, and each on being rotated disengages with the fixed contacts on the two outer insulator stacks to give a simultaneous double break in the three phases.

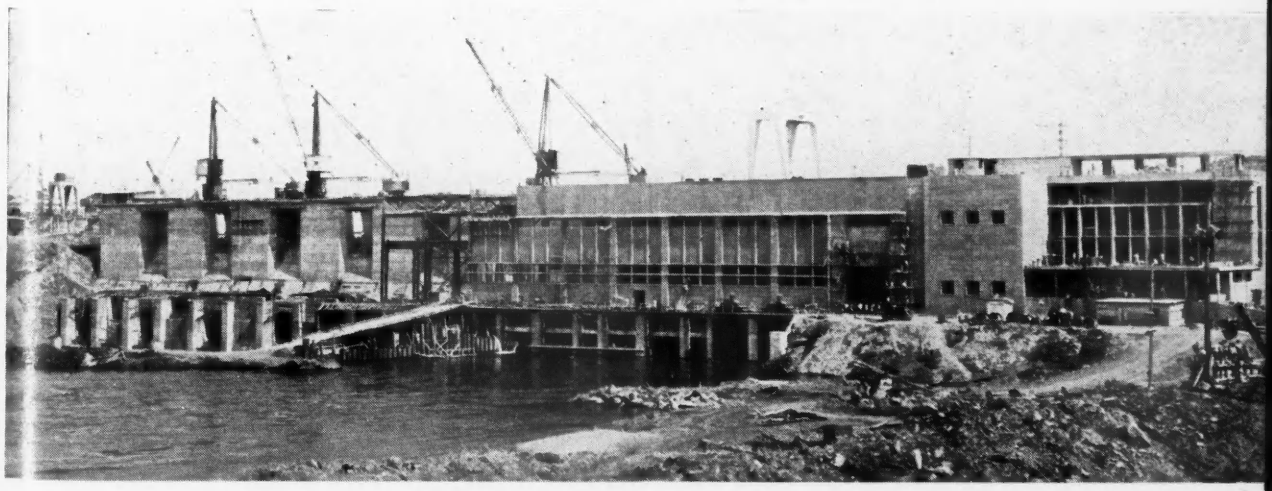
The G.E.C. remote switching control board at present consists of panels arranged in " L " formation. This will later be extended, and the final arrangement will be " U " shaped. The board, of pressed steel construction, is 7ft 9in high. Instruments are mounted at the tops of the panels; the centre portions accommodate an automatically-controlled mimic diagram fitted with discrepancy-type control switches, each of which combines the functions of a circuit breaker control switch and semaphore indicator. The operating handle is a raised bar which completes the line diagram when the corresponding circuit breaker is closed, and breaks it when it is open. A lamp, enclosed by a " Perspex " dome behind the bar, is illuminated automatically if the condition of the circuit breaker and the setting of the operating handle do not coincide.

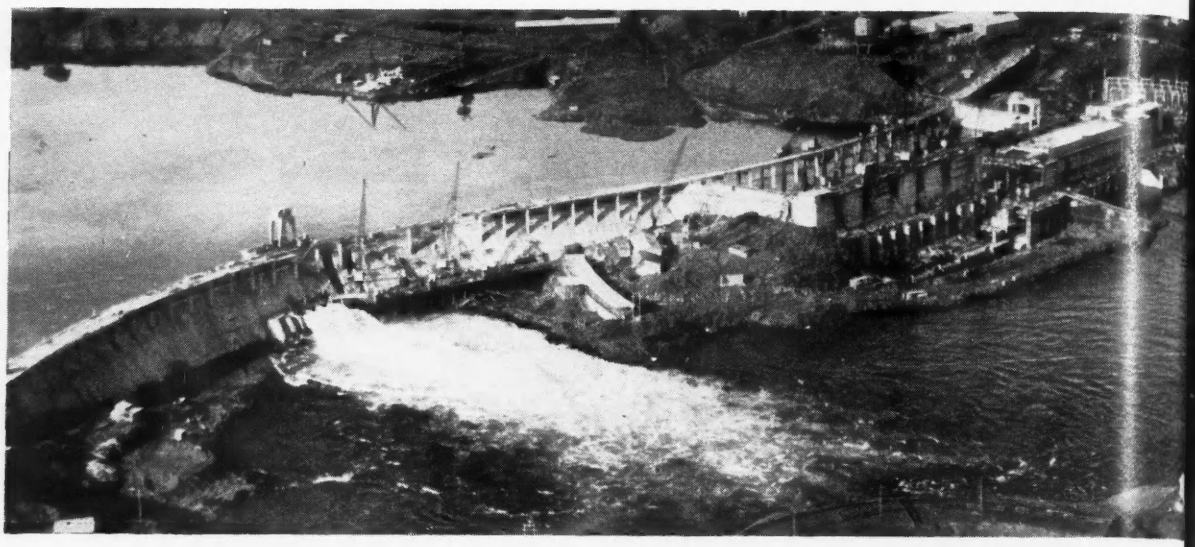
The design of the protective gear is mainly in accordance with standard practice for hydro-electric generating plant, the most notable feature being the use of 63·5 ohm resistors for earthing the generator neutrals. This limits the earth fault current on the 11 kV side to 100 A.

The contract for the supply and installation of paper- and rubber-insulated cables for the first section of the station is being carried out by British Insulated Callender's Cables, Ltd. The generator cables from each set consist of two single-core 11 kV cables per phase protected by a water and fire resisting serving where they are laid internally and a water and termite resisting serving where they are laid externally. These cables, connecting the alternator line cubicles with the switching station, are laid in a cable tunnel running the length of the power station at the foot of the intake dam and terminate in outdoor sealing ends which are directly connected to the transformers. Single-core 11 kV cables have also been used to connect the alternator line cubicles with the 50 kVA auxiliary transformer installed with each generator. The control room is situated at the switching station end of the power station and the control cables run from the control room to the generators and the switching station.

B.I.C.C. is erecting the first 132 kV overhead transmission line in East Africa, approximately 113 route miles

The power station will have an ultimate generating plant capacity of 150 MW





Aerial examination affords an impression of how submerging the Falls and building the dam and power station has changed the character of the Owen Falls site

in length. It runs from Owen Falls to Kampala and from Owen Falls to Tororo. When the projected line to provide a supply from Owen Falls to Nairobi goes into commission the line to Tororo will form the first link in this long-distance transmission scheme.

The overhead transmission line from the power station to Kampala is fed by 7,500 kVA 33/66 kV delta/star connected outdoor oil-immersed naturally cooled Bruce Peebles transformers fitted with detachable radiators, each of which has a hand-operated inlet and outlet valve; an oil conservator with a magnetic type oil gauge; an explosion vent; a reactor type motor-operated on-load tap changer on the 33 kV side to give a voltage variation of $\pm$ 10 per cent in sixteen 1·25 per cent steps, all tappings being fully rated.

Shipment of the plant from England began towards the end of 1952 and further units were dispatched as required by the conditions on the site and when shipping space became available. The machines had to be shipped in sections in order to comply with the limiting weights and dimensions imposed by transport facilities available in East Africa. The nearest port to the site is Mombasa, and from there the plant had to be transported by rail, a distance of just over 800 miles. From Mombasa the line runs for 330 miles to Nairobi, which has an altitude of 5,452ft, while Nakuru, which is 442 miles on, has an altitude of 6,071ft and Rongai, 462 miles from Mombasa, has an altitude of 6,137ft. Here the line commences to climb out of the Great Rift Valley, through forest country, to Sabatai, 489 miles out at 7,248ft altitude, near which the line crosses the equator.

The equator station, 506 miles from Mombasa, has an altitude of 8,706ft, and a little farther on is the highest point of the line at 9,150ft above sea level. Tororo is the first station in Uganda, a distance of 676 miles from Mombasa at an altitude of 3,861ft. The line then proceeds to Mbulamuti, 773 miles out at an altitude of 3,490ft, and goes on to Jinja which is 812 miles from Mombasa, at an altitude of 3,750ft, and is the nearest station to the site. In spite of congestion at the port of Mombasa, the stringent climatic conditions, and the long arduous rail journey, the equipment arrived at its destination in good condition.

The whole of this great project is being undertaken by the Uganda Electricity Board under the chairmanship of Sir Charles Westlake, M.I.E.E., and the consulting engineers are Messrs. Kennedy & Donkin and Sir Alexander Gibb & Partners.

The principal contractors are: Civil engineering and building works, Owen Falls Construction Co.; structural steel, Redpath, Brown & Co., Ltd.; water turbines, Boving & Co., Ltd.; generators, British Thomson-Houston Co., Ltd.; 33 kV switchgear, General Electric Co., Ltd.; transformers, Bruce Peebles & Co., Ltd.; water control gates, Glenfield & Kennedy, Ltd.; 120 ton power house crane, Sir William Arrol & Co., Ltd.; and main cables, British Insulated Callender's Construction Co., Ltd.

Suppliers of sundry equipment include: Clifford & Snell, Ltd., Edison Swan Electric Co., Ltd., E.M.P. Electric, Ltd., Ferranti, Ltd., Line Equipment, Ltd., A. Reyrolle & Co., Ltd., Rheostatic Co., Ltd., Simmonds & Stokes (Niphan), Ltd., and the Watford Electric & Manufacturing Co., Ltd.

Naval Gas Turbines

PARTICULARS of eight designs of gas turbines for the Royal Navy were given in a paper presented by Commander G. F. A. Trewby in New York and Washington at the end of April after a previous reading at the Institute of Marine Engineers. Except for certain types of vessel, such as high speed coastal craft, only from 5 to 30 per cent of the total propulsion power, the author stated, was required for cruising. In an extreme case cited 70 per cent of the installed power was used for 1 per cent of the total steaming life. The aircraft approach in design was adopted rather than established steam practice. The greatest single advantage of the gas turbine for warships was the ability to pack more power in less weight and space than in any other prime mover; this necessitated an open-cycle plant, but ability to burn residual fuel was a condition of replacement of steam for propulsion. Some details were given of the first naval gas turbo-alternator, rated at 1,000 kW and built by W. H. Allen, Sons & Co., for supplying power for fighting equipment and general services. Initial experience with this unit had resulted in an order for two more of 500 kW rating.

VIEWS on the NEWS

By REFLECTOR

SOME stir was made in the daily Press last week about the closing down of twenty small power stations by the British Electricity Authority. It was said that about a hundred men were affected by this but the B.E.A. had assured their trade unions that wherever possible alternative work would be found for them. There is nothing unusual about this action; actually the total amount of plant involved is 9,000 kW, which may be compared with the 16 million kW of generating capacity operated by the B.E.A. In 1952–53 about 100,000 kW of generating and boiler plant was shut down in sixteen stations, including the low-pressure sections of the Ocker Hill, Huddersfield and Thornhill stations.

* * *

My readers may think that initials have become an obsession with me, but I am constantly coming across new aspects which I feel impelled to mention. This time it is a letter in *The Times* which raises the matter again. The writer, Mr. C. T. Rivington, says (as I have pointed out previously) that he has realized for years the initials "B.E.A." stand for British Engineers' Association, British European Airways and British Electricity Authority, but he has now discovered that they can also denote British Esperanto Association. He suggests that some public organization (perhaps the British Standards Institution) should keep a register of short titles of corporate bodies of national importance and that new bodies should be encouraged to consult it before adopting abbreviations. It's a good idea—indeed I have already made a similar proposal.

* * *

Strictly, consumers are required to notify the electricity supply authorities of additions to their installations, but the requirement is never enforced because it is almost certainly unenforceable. Normally distribution systems are designed with a sufficient margin of capacity to take care of normal and reasonable additions and in any event local measurement of demand is sufficient to tell the authority what is going on in a particular district. And yet it is helpful for the authority to know what apparatus is available and likely to be connected and the North Western Electricity Board is instituting a voluntary census among its consumers to find out exactly what equipment they have in service. The reason given for the inquiry (which, consumers are assured, will in no way affect charges) is that it will assist the Board in planning its distribution system for maximum economy and continuity of supply. I can also imagine that it will be useful in discovering what consumers lack in the way of equipment, with a view to inducing them to make the deficiencies good.

* * *

I have always contended that the Electricity Boards should study very carefully the methods of their gas rivals. No doubt they all do but they must go further and match the Gas Boards' terms. Attention has been drawn by the South Eastern Electricity Consultative Council to the fact that because the hire-purchase payments for gas cookers are spread over a longer term the quarterly charge is appreciably lower than it is in the case of electric cookers. The South Eastern Electricity Board is to be asked to extend the period of payment from three to four years. At the Consultative Council meeting a report was presented which pointed out (says the Brighton *Evening Argus*) that consumers could get better terms from private electrical firms than those offered by the Board. And yet it is a frequent complaint of private retailers that they are unable to compete with the Boards because of the latter's ability to obtain cheaper money for financing hire-purchase schemes.

* * *

One of the subjects discussed in the television programme "Panorama" last week was the attempt of book publishers to secure a share of authors' extra income from cinema, radio and other rights. Obviously the general question does not call for treatment in these notes but one point must be mentioned. To illustrate the justice of the publishers' claim a diagram of their increased costs was displayed and one item in this was "gas and electricity" which were alleged to have risen since before the war by 267 per cent. I cannot (or will not) speak for gas but I will contend that it is not true of electricity. The last report of the British Electricity Authority showed that the average revenue per kWh from industrial supplies rose from 0·646d in 1938–39 to 1·088d in 1952–53, i.e., by about 68 per cent. Subsequent increases have certainly not raised this to anything like the figure stated.

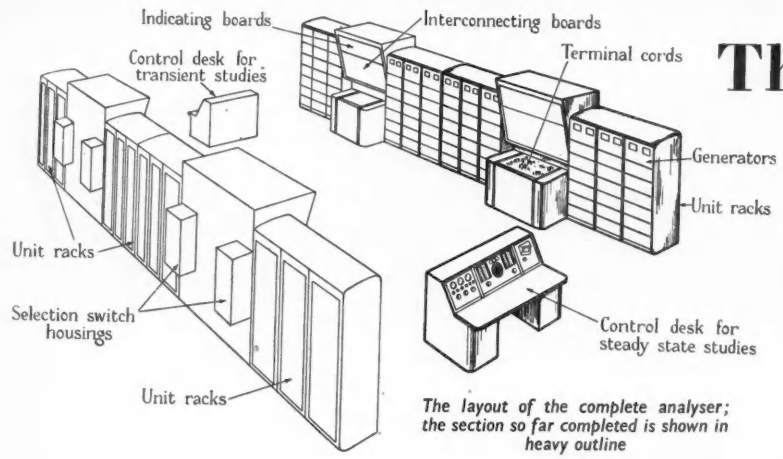
* * *

In the *Electrical Review* of 3rd May, 1884 (seventy years ago) it was reported that the chairman of the Provincial Brush Electric Light & Power Co. thought that the prospects of electric lighting were not so bright as they had hoped and expected at one time, but he felt confident that a turn would take place before very long. Sir Michael Kennedy was speaking at an extraordinary meeting called to consider a reduction of the company's capital. At the meeting Mr. Offor, the manager, described the "B.T.K." system which the company had adopted and referred to an experiment at Colchester which he said consisted of

> "a supply of electricity from a central station to storage stations in different parts of the district from which groups of houses were supplied. The batteries were charged in series by means of that excellent Brush high tension machine, and the delivery was made by means of their rocking switch, and a low tension current; there were no high tension currents in connection with the houses."

From a description in a subsequent issue of the *Electrical Review* (21st June, 1884) it appears that the main advantage of the B.T.K. system was the avoidance of the necessity of perfectly compounded dynamos, very costly conductors, and engines fitted with almost perfect governing gear.

The E.R.A. Network Anal



The layout of the complete analyser; the section so far completed is shown in heavy outline

The Completed Section of the Perivale Installation

SUFFICIENT advance has now been made by the British Electrical and Allied Industries Research Association in its task at the E.R.A. Laboratories at Perivale, London, of designing and creating a supply network analyser for us to have seen recently a considerable portion of it demonstrated very satisfactorily.

When it was first decided to construct the analyser, to be available to the electrical industry for use both for routine and research problems, it was realized that the network elements could in principle be used in three ways : Firstly, for the study of the behaviour of networks in the steady state at or near a single frequency, the purpose for which commercial analysers are specifically intended; secondly, to study the behaviour of electrical networks in a transient state, for because of limitations of performance of the elements, commercial analysers are normally not suitable for this requirement, which is met by smaller, specialized equipments; and thirdly, for the study of the frequency response of networks, facilities for which have, so far as is known, not hitherto been incorporated in conventional network analysers.

A survey showed that components incorporating techniques and materials now standard in the telecommunication industry could form network elements satisfactory for all purposes. Further, a considerable reduction of cost and bulk would be achieved if the operating power level and the frequency range of the analyser were within the range for audio-frequency telecommunication, since standard telecommunication components would then be satisfactory. This would necessarily call for rather sensitive and complicated measuring equipment, but it was estimated that there was an optimum level at which there was a considerable net gain. Further, only inexpensive components would have to be added should any future extension be required.

The above considerations led to the choice of the following base parameters for the analyser: Impedance 100 Ω (10 mH and 1 μF); power 2·5 mW (500 mV and 5 mA); frequency 1·592 kc/s ($\omega = 10^4$ rad/sec); and frequency range 0·159 to 15·9 kc/s ($\omega = 10^3$ to 10^5 rad/sec).

The resolution and repeatability of the measuring equipment should preferably be as high as 0·1 per cent of base amplitude and 0·1 deg of angle for amplitudes greater than 10 per cent. The impedance and power level chosen resulted in a signal of 100 μV for the metering of a current at 100 per cent level. The desired amplitude resolution calls therefore for a sensitivity of 0·1 μV in the current measuring equipment, while the phase resolution requires sensitivity of 0·016 μV.

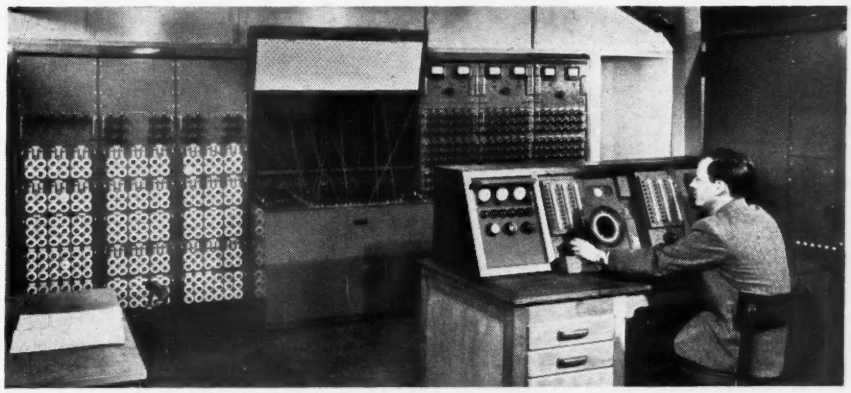
The project was thus one of considerable size and difficulty, requiring a number of years for development and construction. The design was therefore so arranged as to permit progressive commissioning into service of each completed part of the equipment. For proper

TABLE I.—DETAILS OF NETWORK ELEMENTS

Type of Unit	Resistance R%		Reactance X%		Susceptance B%		Connections	Number Available	
	Max.	Steps	Max.	Steps	Max.	Steps		Final	Present
High Impedance (Load)	10100	10	1900	5			Series & Parallel	60	33
Medium Impedance (Load)	1110	1	1900	5			Series & Parallel	42	
Low Impedance (Line)	110	¼	110	¼			Series	126	36
Low Susceptance					109	¼		72	30
High Susceptance					1000	100		48	12
πNetwork	110	¼	110	¼	2×109	¼	π	48	
Steady State Generators	E = 0—400%							18	3
Auto-transformers, Coarse (System Transformers)	100% ±30% in Steps of 0·5%							18	8
Auto-transformers, Fine (Load Adjustors)	100% ±10% in Steps of 0·2%							64	2
Mutual Transformers	Ratio 1 : 1							12	2
Mutual Transformers	Ratio 2 : 1 or $\sqrt{3}$: 1							8	
Amplifiers and Buffers	Gain 10 : 1 or 1 : 1							12	4

NOTE.—48 auto-transformers, 24 high impedance units and 24 medium impedance units will be combined into 48 load units provided with individual voltmeters. Generators and auto-transformer units will incorporate two-decade reactances.

Analyser

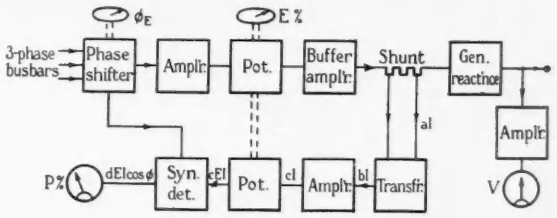


A section of the analyser is now in working order at the E.R.A. Laboratories at Perivale; in the foreground is the control desk incorporating the monitoring and selector panels and the metering dials, and in the rear are network elements, the interconnecting and indicating boards and the slave generators

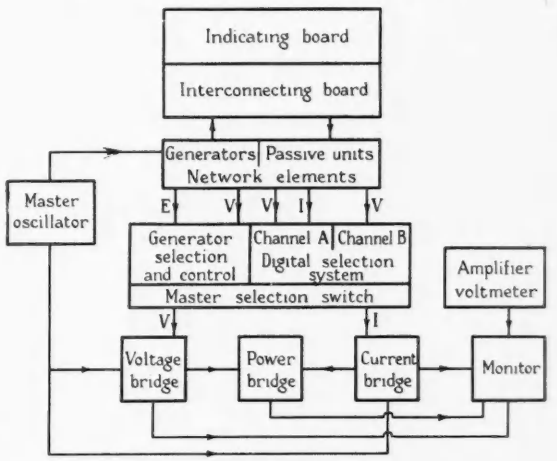
perspective, however, the parts at present serviceable should be seen as elements of the complete design. This comprises eight wings of racks housing the network elements which are connected to four interconnecting units or plugboards with the central measuring equipments for the steady state and transient studies, respectively, in two control desks placed at the opposite ends of the array. All the network elements will be available for use in conjunction with either control desk on problems of exceptional magnitude. Normally, however, the wings of racks and the plugboards will be suitably apportioned between the two desks, so that studies may be carried out simultaneously on two independent networks, thus giving a high utilization factor for the equipment.

A single wing of racks and a small plugboard was first constructed and put into service in 1951, and in conjunction with commercial transient generating and measuring equipment has been successfully used for the solution of transient state problems. This has now been supplemented by a second wing of racks, a full-size plugboard, three steady-state generators, and the steady-state control desk with the full equipment required for use with the complete analyser. The absolute accuracy of the main metering system is within ± 1 per cent at the base frequency and the targets of resolution and repeatability have been achieved. Measurements can be made over the whole frequency range of the analyser, but at the moment the accuracy falls off considerably near the extremes of the range. Obviously with an equipment of such size and complexity a considerable amount of adjustment and testing will be required in order to secure the best performance.

The "passive" network elements consist of two terminal elements, such as decade impedances or simple series or parallel arrangements of these, and three- or four-terminal elements such as π networks and transformers, together with some electronic amplifiers. The terminals of each two-terminal element are brought out and identified by colour (red or black) at the ends of flexible conductors at a plugboard. Three- or four-terminal units are treated as pairs of two-terminal units.



Schematic diagram of the steady state generators

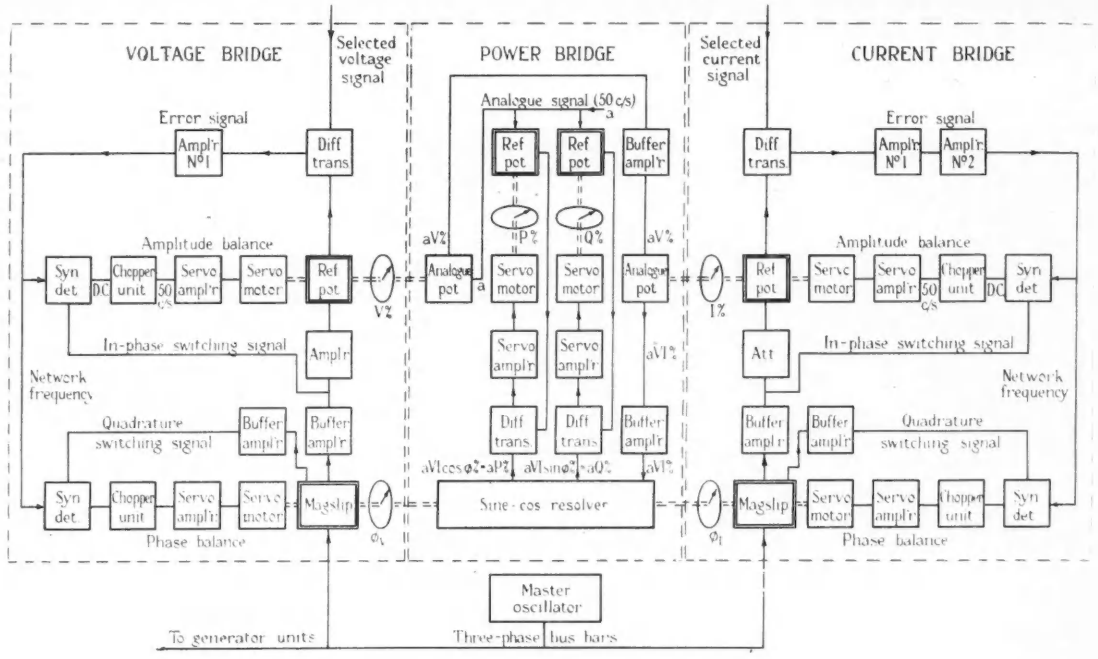


A general operational arrangement for steady state studies

TABLE 2.—TYPES OF COMPONENTS USED IN THE UNITS

Components	Range	Type	Stability	Tolerance
Resistors	0·25—4Ω	Wire Wound, Thin Card	±0·75%	±40mΩ
	10—1000Ω	Wire Wound, Tubular, Non-inductive ...	±1%	±1%
	1000Ω	Cracked Carbon	±1%	±1%
Capacitors	0·0025—0·04μF	Silvered Mica	±0·05%	±1%
	0·1—4μF	Oil Impregnated Paper, High Stability ...	±1%	±1%
Inductors	25 and 50μH	Toroidal Dust Core, Screened Double Units	±1%	±4μH
	0·1—40mH	Toroidal Dust Core, Screened Decade Units	±1%	±1%
	100mH	Toroidal Dust Core, Screened	±1%	±1%

Each unit has also four terminals available for the purpose of metering, i.e., two voltage terminals and two current terminals. The latter are the potential terminals of a 20 mΩ shunt incorporated in the red lead of each unit. The constituents and the impedance range of the various types of units are given in detail in Table 1, together with the number of units provided for and the number already available. The most important features of these units are accuracy and compactness. The accuracy is in general



Detailed arrangement of the bridge measuring system

within 1 per cent of the nominal setting or 0·1 per cent of the base value, so that for most problems the dial readings can be used without any corrections. The purity of the reactive components is also better than 1 per cent at the base frequency. The types of components used are listed in Table 2. The size of the components is so small that for all but the high susceptance units the space taken up in the racks is determined by the front panel requirements for the indicating dials. Small and inexpensive wafer-type switches with silver alloy contacts used both in the network units and in the selector system have proved completely satisfactory.

Three "generators" have so far been constructed to act as steady state power sources. These "generators" are in fact adjustable amplifiers, with an independent phase and amplitude control in each unit. The output amplifier ensures a low output impedance of 0·3 Ω. Provision has been made for the insertion of built-in adjustable reactances and power and terminal voltage monitors, which will result in a considerable economy of time required to achieve the initial balance in load flow studies. It is expected that the additional generators to be constructed will incorporate results of research now in progress at several centres, aimed at producing self-adjusting units embodying all the important characteristics of the actual machines.

The main measuring system consists of three automatic a.c. potentiometers operating simultaneously to indicate the potential difference V (amplitude and phase) between the selected points in the network, the current I through the selected unit (amplitude and phase), the direct phase difference ϕ between V and I and the products VI cos ϕ and VI sin ϕ. The last give the active and reactive load (watts P and vars Q) when V and I refer to voltage across and current through a unit or network. An independent direct voltmeter is also provided mainly for the purpose of quick checks and for monitoring a voltage across one unit while adjustments may be made to other units.

The reference signal for the bridge measurement is derived from the same three-phase master oscillator which provides excitation for the generator units. For the arrangement of the three bridges shown above it will be seen that the measurement of voltage (or current) is made by comparing the selected voltage signal from the network nodes (or from a shunt) with a reference signal derived from a potentiometer. The difference of these two voltages operates a servo-system which adjusts the slider position on the potentiometer and the phase of the signal supplied to the potentiometer until a balance is obtained.

The angular positions of the shafts of the potentiometers and phase shifters are coupled to dials on the control desk which display current and voltage in amplitude and in phase relative to a reference signal, together with the phase angle between them.

The measurement of active and reactive load, which is usually difficult in variable frequency systems, has been made fairly easy by the use of an analogue method. The multiplying operations required are performed on a fixed frequency analogue signal by means of potentiometers and a sine-cosine resolver ganged with the voltage and current bridges. The accuracy of these operations is governed by the linearity of the potentiometers (which is 0·1 per cent) and linearity of the sine-cosine resolver. The latter at present introduces errors of up to 2 per cent at low power levels, but these will be eliminated by a rearrangement of the circuit permitting the operation of the resolver at a fixed voltage level. The bridge method of measurement is necessarily somewhat slower in giving an indication than is a direct measurement. This is compensated by the greatly increased scale length achieved (20in), which reduces the time and effort of the operator in taking a reading.

The direct measurement of voltage is made by means of an amplifier-operated rectifier instrument. Amplitude only is measured, but phase angle may be indicated on one of the monitoring cathode-ray tubes. Three such tubes are provided for the permanent display of voltage waveforms at important points in the measuring system

which can be selected at will, thus facilitating adjustment and giving immediate indication of faults.

To each impedance unit is assigned a three-digit number. The first digit denotes the wing of racks in which a unit is situated, and the plugboard at which its terminals are available, the second and third denote the type of unit and its serial number. Selector gates, i.e., banks of relays housed behind the plugboards, are operated by push-button controls at the control desk and connect the measuring equipment to the metering terminals of a unit.

There are two independent channels of selection, A and B. Channel A has both voltage and current leads and normally connects to the bridge equipment; channel B has voltage leads only and normally connects to the amplifier voltmeter. In addition each channel has its own potential lead (green and blue for channels A and B, respectively) which may be plugged in anywhere in the network, but will usually be connected to the neutral bar. Thus three voltage terminals are available in each channel, and several schemes of measurement are possible through the use of a master selection switch. By the use of the two channels with the bridge equipment voltage and current may be measured in different units simultaneously, so that mutual effects in a network may easily be studied or the product of two unrelated synchronous complex quantities obtained.

It was estimated that the generators would most often be selected. An additional single-digit selector channel has therefore been provided to make them more readily available. The phase and magnitude of a generator thus selected may be adjusted from the control desk. It is also possible to make such an adjustment while some other unit is selected for measurement through channels A or B.

The part of the analyser now constructed is fully representative of the complete equipment. The evidence of its performance so far obtained is very encouraging, and the analyser is now available for the solution of problems within its range. In addition to the normal power system problems, the more obvious uses are for studies in transient response of networks, frequency response of networks, and, because of inclusion of isolating elements, i.e., amplifiers, the analysis of feedback amplifiers and servo-systems. Techniques for the latter fields, and specialized auxiliaries for the most efficient applications, naturally require development, and it is expected that this will be pursued in parallel with the use of the existing equipment and construction of its complement. The central measuring equipment may be used as a very sensitive and versatile a.c. potentiometer, independent of the network.

It is expected that the complete equipment will be first available in the new E.R.A. Laboratories at Leatherhead, but in the meantime extension to one half, and possible three quarters of the complete installation will be carried out at Perivale, where the equipment has been and will continue to be available for general use.

Five classes of work are envisaged in the following order of priority: (*a*) Work within the general framework of E.R.A. programmes; (*b*) work for individual members which is essentially of a research character; (*c*) solution for members of problems which are not of a research character; (*d*) work for other central organizations; (*e*) work for non-members. Special consideration will be given before work in the last two categories is undertaken.

A later and more complete account of this analyser must certainly include acknowledgment of the great benefit received by the Association from the expert advice of individuals on the staff of member firms.

RADIO RESEARCH

Report on Government Sponsored Work during 1953

THE report of the Radio Research Board, which includes the report of the Director of Radio Research for the year 1953, has just been published for the Department of Scientific and Industrial Research (H.M. Stationery Office, 1s 9d).

One of the major studies at the Radio Research Station at Slough, Bucks, continues to be into ionospheric "weather" and its effect on long-distance radio communication. Data on local ionospheric conditions are supplied to the Station from its own and other observatories in various parts of the world and this information is used in the preparation of forecasts six months ahead of transmission conditions for the users of high frequency radio communications. A recent development has been the construction of special "British Zone" charts which forecast conditions for circuits terminating in the British Isles. It is hoped that these local charts will give more accurate forecasts than the general charts previously used.

The Station is also using a method of investigating ionospheric conditions by studying long-distance back-scatter ("echoes") from the earth's surface of high power pulses transmitted from the observation point. Sharply beamed aerial systems directed along fixed azimuths and capable of operating over a wide frequency band are used for this purpose. A rotating beamed aerial system of restricted frequency coverage has also been developed for use with a Plan Position Indicator (P.P.I.) display. Propagation conditions within a circular area of 5,000 km radius from the observation point are shown on the P.P.I. as the aerial rotates. In addition a camera is arranged to take one photograph at each revolution of the aerial. By projecting the developed film at a greatly increased speed a vivid picture is obtained of ionospheric changes within 5,000 km of Slough.

The study of phase changes in low frequency ground waves as they pass over geological boundaries or from a path over land to a path over water is important for those types of radio aids for marine and air navigation which are based on the reception of low frequency signals from fixed transmitters. The new system of phase measurement which employs an ultra-high-frequency radio link to convey a phase-reference signal has been completed and proved satisfactory in use. The results show that there is a phase disturbance at a coast line similar to that found over marked boundaries in geological structure. Phase variations have also been found in radio waves passing near, and parallel to, a coastline.

The work of the Station on germanium diodes included the examination of the current-voltage-temperature characteristics and noise spectra of point-contact and junction diodes together with related theoretical studies.

The increasing use of the frequency bands above 30 Mc/s and their importance for the development of television and other uses has made the study of the propagation of very short waves an important one. An investigation of ground wave propagation over irregular terrain at frequencies of 100 and 600 Mc/s has been made and propagation curves for general use have been constructed for the band 50 to 800 Mc/s. At larger distances a study has also been made of the effect of weather conditions on field strength levels. The statistical information gained, together with data supplied by the G.P.O. and the B.B.C., has been used in the preparation of propagation curves which have been adopted by the International Radio Consultative Committee for general use in the appropriate geographical regions.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

AT the inauguration of the Owen Falls hydro-electric scheme on Thursday of last week, described elsewhere in this issue, the Queen spoke of the great skill which had enabled the waters of the Nile to be harnessed for the generation of electric power. "Without power," she said,

The Queen, accompanied by Sir Charles Westlake. walks down the steps after performing the opening ceremony

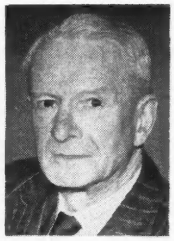
"there can be no economic development and without power no country can go forward in the modern world." This great work was welcomed, therefore, because by increasing the wealth of the country it would enable the African people to advance to a much higher standard of living. The Queen was confident that future generations in Uganda would look upon this scheme as a landmark in the forward march of their country, and "not only will this dam produce power for Uganda; it is also designed to store water for Egypt. This part of the scheme, which is an example of practical co-operation between nations, is of broad scope and of greatest importance to the future welfare of all dwellers in the Nile Valley."

Earlier Mr. Oliver Lyttelton, the Colonial Secretary, had read a message of goodwill from Sir Winston Churchill, on behalf of the Government, and the Queen's reply in which she referred to the prophecy Sir Winston had written nearly 50 years ago in "My African Journey" after visiting the area: "It would be perfectly easy to let the Nile begin its long and beneficent journey by leaping through a turbine.... Jinja is destined to become a very important place in the economy of Central Africa."

Sir Charles Westlake, chairman of the Uganda Electricity Board, said that Her Majesty's presence set the seal on the work of many thousands. There had been no labour troubles; over 2,000 Africans had been employed in addition to more than 200 Europeans and Asians. The scheme was a triumph of British skill in design and execution. The whole of the plant was imported from Britain, and during the past eighteen months cement had been provided from Uganda's own plant. The scheme was a contribution to the advancement of Uganda.

A new appointment, that of chief engineer to the Communications Division, has been announced by Marconi's Wireless Telegraph Co., Ltd. This post is to be held by **Mr. C. Gillam,** who will now be working in conjunction with **Mr. A. W. Cole,** the manager of the Division. Mr. Gillam first joined the company in 1930 and after some years with the transmitter test section, he spent four years in Turkey installing and maintaining high power broadcasting transmitters. Returning to England in 1942, he took over responsibility for aerial designs and became chief of the aerial design and systems planning group on its formation in 1948.

At last week's luncheon of the Batti-Wallahs' Society, **Mr. C. N. Good,** A.M.I.E.E., was formally installed as president of the Society for the ensuing year, **Mr. A. G. Freeborn,** the outgoing president, investing him with the chain of office, following which Mr. Good presented Mr. Freeborn with the past - president's badge.



Mr. C. N. Good

Mr. Good has for the past forty-five years been on the staff of Chloride Batteries, Ltd., and has been closely concerned with submarine batteries since the 1914-18 war. He entered the electrical industry in 1902 when he spent three years in the electrical department of Holloway Bros., Ltd., from which the firm of H. J. Cash & Co., Ltd., has since developed. He attended a two-year course at the Finsbury Technical College before going in 1907 to the Adams Manufacturing Co. (now the Igranic Electric Co.). A year later he went to the Electrical Power Engineering Co., Ltd., before joining Chloride in 1909. Mr. Good has served on a number of B.S.I. committees.

After luncheon an address was given by Admiral Sir George Grantham, K.C.B., C.B.E., D.S.O., on "Surveying in the Navy," in which he indicated some of the advances which had been made in charting since the days of Captain Cook.

Mr. H. W. Bowen, O.B.E., M.I.Mech.E., has been appointed technical director to H. J. Baldwin & Co., Ltd., and consulting engineer to the Baldwin group of companies. He is a chartered mechanical engineer and a member of the Institution of Production Engineers, of which he is also a member of the Council and a past president of the London Section. Mr. Bowen has had a wide and distinguished career on the production side of engineering. He was for four years on production work with the Ford Motor Co., and seven years an executive with Vickers Armstrong. He was associated with E.M.I. for thirteen years, primarily as production manager and eventually for five years as managing director of E.M.I. Factories, Ltd. He is also a director of Air Trainers, Ltd., Clark Matthew, Ltd., and chairman of High Pressure Components, Ltd.

Mr. H. W. Bowen

Mr. W. D. Wilson, M.I.Prod.E., has been appointed a director of Newman Industries, Ltd. He joined the company in 1935 as works manager, and was previously with Crompton Parkinson, Ltd., for twelve years and with Bruce Peebles & Co., Ltd., for six years. He will continue in his present executive capacity as general manager of the company's Grantham Works.

Mr. W. H. Allen, A.M.I.M.E., M.J.I.E., has resigned his appointment with Preece, Cardew & Rider, consulting engineers, to take up the appointment of production engineer to the Bermuda Electric Light Co., Ltd. He leaves by air on 20th May. Mr. Allen received his training with the English Electric Co., Ltd., and before

joining Preece, Cardew & Rider, was deputy manager of the Karachi Electric Supply Corporation, Ltd.

Mr. **A. J. Budd,** B.Sc.Tech., has been appointed assistant superintendent of the Leonard Works of the Metropolitan - Vickers Electrical Co., Ltd. Mr. Budd took his degree at Manchester and went to Metropolitan - Vickers as a college apprentice in 1943, subsequently joining the staff of the Motor Engineering Department as a junior engineer. Later he transferred to the manufacturing side of the department, and in 1949 he was appointed development engineer. He has been assistant superintendent, Motor Department, since October, 1951.

Mr. A. J. Budd

Mr. D. A. Thomson, B.Sc., has been appointed to the board of the Belmos Co., Ltd. He joined the company in 1947 after service in the Army, in which he held the rank of major.

Mr. Miles Beevor, managing director of the Brush Group, left by air on 2nd May on a visit to Ceylon, Singapore, Australia and Canada.

Before calling upon Mr. J. A. Ratcliffe, O.B.E., M.A., F.R.S., to deliver the forty-fifth Kelvin Lecture on "The Physics of the Ionosphere" last week at the Institution of Electrical Engineers, Mr. H. Bishop, the president of the Institution, presented a vellum certificate to **Mr. Ernest Leete,** recording his election as an honorary member of the Institution, and the Faraday Medal for 1954 to **Mr. Isaac Shoenberg,** M.I.E.E. Mr. Bishop said that Mr. Leete had been elected to honorary membership for his outstanding services to the Institution, in particular for his services as honorary treasurer and as an ordinary member of the Council over a period of almost a quarter of a century and also for his work on behalf of the Benevolent Fund of the Institution over a similar period of years.

The thirty-second award of the Faraday Medal was made to Mr. Shoenberg for his distinguished work in electrical engineering, in particular the outstanding contributions which he had made to the development of high definition television in this country. In reaching its decision, the Council recognized the fact that had it not been for Mr. Shoenberg's pertinacity and faith in the new medium this country would not have had a high definition television system for some years after 1936, almost certainly not until after the 1939-45 war. As it was the service in this country was able to start four years in advance of any other country.

In a brief response, Mr. Shoenberg thanked the Institution for the honour which had been conferred upon him and paid tribute to the fine team which he had directed and to his company for its courage and vision in approving the heavy expenditure which was necessary.

Mr. E. F. Johnson has been appointed sales manager of Cimex-Fraser Tuson, Ltd. His office will be at the company's headquarters at Orpington, Kent.

Mr. E. Morris, M.S.M.A., who has held the position of field sales manager of Truvox, Ltd., for the last six years, has been appointed general sales manager responsible to the general manager and director, Mr. F. Good. **Mr. A. J. Catlin** has been appointed field sales manager. He joined the company in 1948 as an area representative, and after three years' service was appointed manager of the industrial sales division. This division is now incorporated into the general sales organization and Mr. Catlin will be responsible for the whole of the outside selling staff.

Mr E Morris

Mr. A. J. Catlin

Mr. L. A. H. Twyford, who was recently appointed assistant export manager of E. K. Cole, Ltd., is now on a business tour of the Far East.

Mr. C. B. Griffiths has been appointed sales manager of Pyrotenax, Ltd. He was previously contracts manager to the company.

Mr. S. C. T. Cox, A.M.I.E.E., has joined Gresham Transformers, Ltd., and will represent the company in the industrial field. Mr. Cox was educated at Kingston Grammar School and Wimbledon Technical College, and was for twenty-two years with Foster Transformers, Ltd.

Mr. B. D. Jenkins, B.Sc., A.M.I.E.E., after graduating at University College, Cardiff, in 1945, served with South Wales Switchgear, Ltd., until this year, when he joined the design staff of Gresham Transformers, Ltd., prior to representing the company in respect of power distribution transformers.

Mr. S. C. T. Cox

Mr. B. D. Jenkins

Mr. E. F. Alldritt

Mr. E. F. Alldritt has also joined Gresham Transformers, as publicity manager. He has held a similar position with Bull Motors, E. R. & F. Turner, Ltd., and before that was assistant publicity manager with the Kelvin-Hughes group of companies.

Col. B. H. Leeson, T.D., C.B.E., M.I.E.E., was re-elected chairman of the Association of Short-Circuit Testing Authorities at the annual general meeting held on 27th April.

Lt.-Col. C. H. Blackburn, managing director of C. H. Blackburn & Co., Ltd., and of E. Dawson (Lamp Factors), Ltd., has been honoured by appointment as Aide-de-Camp to Her Majesty the Queen. Col. Blackburn commands an R.A.O.C. reserve unit in the Army Emergency Reserve.

Following the reorganization of the companies controlled by **International Combustion (Holdings), Ltd.,** as from 31st March, the details of the new boards of directors are announced as follows:—

International Combustion, Ltd.—Messrs. F. T. Edmunds, J. P. Gilliver, H. W. Hollands, J. Mayer, W. Messer, F. G. Penny, Vernon Young and H. C. Short (secretary). International Combustion (Export), Ltd.—Mr. W. Grainger, Viscount Hall, and Messrs. W. Messer, F. G. Penny, Vernon Young and H. C. Short (secretary). International Combustion Products, Ltd.—Messrs. J. P. Gilliver, W. F. Harlow, H. A. Paxton, F. G. Penny, J. W. Wray, Vernon Young and H. C. Short (secretary). The directors of International Combustion (Holdings), Ltd., and the Riley Stoker Co., Ltd., remain unchanged.

The annual staff dance of **Berry Wiggins & Co., Ltd.,** was held on 23rd April at the Victoria Halls, London, W.C.1, when 450 employees and guests attended. Among those who attended were Mr. R. F. Kempston, sales manager, and Mrs. Kempston.

Mr. John Creek has been appointed to the board of Fibreglass, Ltd., as sales director. After taking a degree at Corpus Christi College, Oxford, Mr. Creek was trained with the United

Steel Co., Sheffield, remaining with them until the outbreak of war when he served with the Queen's Royal Regiment, becoming a lieutenant-colonel. Later he was assistant general manager with the Leather Export Corporation and joined Fibreglass, Ltd., in 1952 as general sales manager. He is also a director of the recently formed F.A. (Membranes), Ltd.

Owing to the illness of Mr. E. F. Schumacher, the annual lecture to the Utilization Section of the **Institution of Electrical Engineers** will now be given by Mr. Donald Hicks, Director of Scientific Control, National Coal Board, on Thursday next at 5.30 p.m.

OBITUARY

Mr. Phillip T. Ward, a director of Thos. W. Ward, Ltd., died on 29th April in a Sheffield hospital, after a long illness. He was thirty-five years of age. The son of Mr. Ashley S. Ward, who is president of Thos. W. Ward, Ltd., Mr. Phillip Ward was educated at Charterhouse, and served for the greater part of the war in Fighter Command, R.A.F. He saw service in Madagascar, North Africa, Burma and Europe. He commenced his career with Thos. W. Ward, Ltd., in 1937 and was appointed a full director in 1948. He was also a director of Birchley Rolling Mills, Ltd., the Darlington Railway Plant & Foundry Co., Ltd., and John Williams (Wishaw), Ltd.

Prof. F. L. Hopwood.—The death occurred on 2nd May at the age of seventy of Professor Frank Lloyd Hopwood, D.Sc.(London), Professor Emeritus of Physics in the University of London since 1949, consulting physicist to St. Bartholomew's Hospital, and hon. secretary of the British Empire Cancer Campaign. He was known internationally for his radiological work and for his investigations of radiation therapy for the treatment of cancer.

WILLS

Mr. Theodore Settle, Ph.D., M.I.E.E., of Sonningdene, Sonning, near Reading, for many years with the General Electric Co., Ltd., who died on 5th November last, left £26,413 gross (£18,212 net).

Mr. E. Ridley, M.B.E., M.I.E.E., formerly principal technical assistant (special services) in the Architect's Department, London County Council, who died on 11th January last, left £8,879 gross (£8, 745 net).

Mr. W. Young, A.M.I.E.E., a former deputy borough electrical engineer of Stepney, who died on 7th February last, left £3,597 gross (£3,529 net).

Toronto Subway

We regret that we omitted to mention in the article on the new Toronto Subway in our issue of 30th April that we were indebted to *British Engineering* for the material and photographs.

Parliamentary Report

IN MOVING THE third reading of the Atomic Energy Authority Bill in the House of Commons last week, Sir David Eccles, the Minister of Works, said that the atomic energy project was becoming more and more a major industry, yet it did not earn an appreciable income, and therefore, as they had seen in Clause 4, it had to be treated very much like a Government department. On the other hand, the project would not expand as it would if it were serving the public like the British Electricity Authority. It would remain more or less an incubator which would hatch the ideas of the research people, and these would be followed up by industry. Therefore, the relations between the new project and industry were of the utmost importance. The conversations with private industry and with the B.E.A. were going on well, and it might be that when the Bill came before the House of Lords it would be possible to give more details of what was a fascinating outlook, namely, that they would be able to establish in this country a new major industry as a result of the discoveries on the industrial side of atomic energy.

Mr. George Strauss said that the Opposition thought the main objective of the Bill was foolish and unwise. Although the Opposition believed it to be a mistake, at this stage at any rate, to separate the atomic energy activities of the Government from a Government department and to set up this new authority, they wished that those who would now guide and control it would be successful. The Opposition would give them all the help they could to ensure that their activities served the nation increasingly as speedily as possible. On their shoulders would lie an enormous responsibility, and on the success of their activities would depend more than on the politicians and statesmen who guided this country on economic matters the prosperity of the people in 50 years' time.

The Bill was read the third time by 193 votes to 167.

Television Plans

Mr. Mayhew asked the Assistant Postmaster-General how many applications to operate as television programme contractors he had received; and how many he still had under consideration.

Mr. Gammans said that the Postmaster-General had had preliminary discussions with 46 individuals or bodies who were interested; it would be for the authority, when it was set up, to make definite arrangements with programme contractors.

Mr. Mayhew asked what representations had been received in favour of the establishment of a monopoly of commercial television in the London area, and what reply had been given.

Mr. Gammans said two had been received. No reply had been given other than that this was a matter for the authority when it was set up.

Purchase Tax on Hired Goods

During the second reading debate on the Finance Bill, Mr. Boyd-Carpenter, the Financial Secretary to the Treasury, said that under the present law a firm or person making chargeable goods, either for sale, or for sale and hire, was liable to be registered and to pay purchase tax if sales and or hirings exceeded the normal £500 limit. But if they made goods only for hiring they were not liable to registration and so escaped tax liability, however large the output. That loophole had been discovered by some firms in the radio and television trade who manufactured sets solely for hire. Clause 7 of the Bill provided that they should be placed on the same tax basis as the other firms. This loophole had been a real threat to the revenue and, through one firm, had resulted in the loss of £100,000.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £156 0s 0d
COPPER, H.C. Electro	ton £243 10s 0d
Fire Refined 99·70%	ton £242 0s 0d
Fire Refined 99·50%	ton £241 0s 0d
COPPER Tubes ..	lb 2s 4½d
Sheet	ton £307 5s 0d
H.C. wire and strip	ton £276 10s 0d
LEAD, English ..	ton £92 15s 0d
Foreign	ton £91 0s 0d
MERCURY	flask £82 10s 0d
TIN, block (English) ..	ton £710 0s 0d
ZINC, G.O.B. Foreign	ton £78 15s 0d
Electrolytic	ton £87 2s 6d
BRASS Tubes (solid drawn)	lb 1s 11⅛d
Sheet	ton £249 0s 0d
Wire	lb 2s 6½d
PHOSPHOR BRONZE Wire	lb 3s 10½d
PLATINUM	oz £30 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 18½d–18⅝d

Arrow Switches Exhibition

A private exhibition to which local engineers are invited is being held by Arrow Electric Switches, Ltd., at the Midland Hotel, Bradford, on 11th and 12th May. The exhibits will comprise the company's latest range of modern control gear and relays.

New Cuban Station

The first 30,000 kW unit of the new plant being built by the Cuban Electricity Company in Regla, Havana, was inaugurated recently. A second set with a capacity of 40,000 kW is expected to come into service in 1955. Two other units are planned.

The Case for the Trolley-Bus

London Transport's Decision Questioned

By A. A. MORRIS

THE electrical industry may well have heard the news of London's abandonment of trolley-buses with something more than surprise. Nearly 750 million passengers a year—many more than travel by Underground—are to be given alternative transport. This decision, which routes 40 per cent of the country's trolley-buses—the largest trolley-bus system in the world—to the scrap heap, and that within three years, implies such a wholehearted rejection of electric public service vehicles that it warrants the closest examination.

Without the benefit of the evidence which the Executive must have considered and the experience which they must have brought to its consideration it is presumptuous to criticize the decision as such. Nevertheless the trolley-bus has been tried in a variety of circumstances over a substantial period of time. It has achieved a distinct measure of success and there is a solid body of transport opinion in its favour. It would not therefore seem improper to consider the claims of the trolley-bus in comparison with the oil bus in general terms to see whether light can thereby be thrown on London's decision.

First let it be accepted that in city transport there is a proper place for a variety of transport methods. Surface trains, subways, tramcars, trolley-buses and oil buses all have a special function for which they and they alone are best fitted. Inevitably these functions overlap and time could be wasted considering these special circumstances on such a wide basis. Isolating instead a special type of problem, that of carrying consistent all-day traffic with heavy periodic peaks, it is possible to find common ground upon which to compare the individual characteristics of two vehicle types. It will readily be agreed that the prime function of a public transport unit is to carry people quickly, safely, comfortably and cheaply and the usefulness of types of vehicle can be compared on this basis. Certain other factors bear on the choice of transport methods, such as civic and national advantage, amenity, etc., but from a transport authority's point of view operating considerations are paramount.

Operating Comparisons

The trolley-bus and oil bus can be considered in turn under various headings. Firstly speed: a prominent transport engineer has published a comparative table showing horse-power available at the road wheels at various speeds for a 110 h.p. oil bus and a 95 h.p. trolley-bus of similar weight and maximum speeds. At 13 m.p.h., for example, the trolley-bus has 168 h.p. against the oil bus, in second gear, with 102. At 15 m.p.h. the figures are 170 for the trolley-bus against 78 for the oil bus. Thereafter the margin narrows progressively until at 21 m.p.h. the trolley-bus's 109 h.p. compares with 102 for the oil bus in third gear. This engineer's conclusion that "there is a considerably increased ratio of power available either for acceleration or hill climbing in the case of the trolley-bus" will be accepted by most transport engineers. This applies to the speed range to 20 m.p.h., the range in which public service vehicles with frequent stops usually operate.

Of these two vehicles, clearly the trolley-bus, with its superior middle speed acceleration, can operate the faster schedule. Higher rates of braking are possible to the trolley-bus and for this reason also faster schedules can be operated. Speed of manœuvre is sensibly similar in each case although the simpler two-pedal control of the trolley-bus gives certain advantages in this respect to the electric vehicle.

While it would appear to be fairer to compare like vehicles it is a fact that the average double-deck bus carries appreciably fewer passengers during rush hours than the trolley-bus. Passengers therefore in the trolley-bus queue get home quicker.

The smooth torque of the electric motor when accelerating or braking permits faster, safe, road speeds in greasy wet or icy road conditions. On all counts it would appear that the trolley-bus has the soundest of claims to be the faster traffic moving vehicle.

Safety and Comfort

Some of the points material to consideration of safety have already arisen in the foregoing. Ease of manœuvre is important, the fewer controls of the trolley-bus offering less distraction from road problems. Good road holding minimizes skid dangers. While an oil bus has only friction brakes, the trolley-bus relies on smooth electric braking, using friction brakes only from low speeds. Another quotation from the aforementioned transport engineer can be used to sum up. "The accident record of trolley-buses usually shows a reduction in insurance costs."

The first rides in the two vehicles will demonstrate the difference in comfort, even when comparison is made between an old trolley-bus and new oil bus. In a trolley-bus the smoothness of acceleration and braking, the absence of power noise and shock, above all the absence of the vibration at rest, so typical of the modern oil engine, are most marked. The reduction of racking strains on the electric vehicle's body not only brings maintenance dividends but also diminishes coachwork creaks and draughts.

Cheapness

Cost per mile is a difficult factor to isolate. It is made up of so many components: prime cost of vehicles and equipment, amortization at varying rates, fuel costs, maintenance costs, payments to rate funds, vehicle availability, etc., that considerable space would be necessary to deal with this aspect of the subject alone. However, the experience of a large number of undertakings using both oil buses and trolley-buses has established the inherent economic advantage of the latter in dense traffic areas of the sort under consideration.

Three main factors are responsible for this. The

trolley-bus, although its price new is greater, lasts so much longer than an oil bus that in relation to years of service its cost is appreciably the lower. It is significant that more than 90 per cent of London trolley-buses are pre-war while almost 90 per cent of the bus fleet is post-war.

In spite of the need for overhead epuipment and substations the per mile cost of power of the trolley-bus is lower than the cost of fuel for the oil bus. (In America where fuel and power costs are substantially similar there is nevertheless a very large number of trolley-bus fleets.) Overhead equipment while fairly expensive in first cost has, in major respects, probably a life of 40 years (of which less than 20 have elapsed on London's system).

Lower Maintenance Costs

Trolley-bus maintenance is very much simpler, less frequent and less expensive than the repair of oil buses, a fact reflected not only in smaller electrical maintenance staffs, and lower expenditure on workshop facilities for the trolley-bus, but also in the greater availability of the electric vehicle.

Compared with the major engineering work often necessary to keep an internal combustion engine in order, periodic maintenance of trolley-buses amounts to little more than blowing dust from motors, changing carbon brushes at long intervals and occasional replacements of contactor tips. The electric motor is of course essentially simple in design and its higher efficiency remains constant throughout its life whereas the inevitable decline of power between overhauls is a characteristic of the internal combustion engine.

Capital investment, then, is less for trolley-buses—because amortized over longer periods—power costs are lower, and so is the cost of maintenance.

The trolley-bus then is safer, it is quicker, it is more comfortable and it is cheaper. It also has certain advantages of a broader nature of interest to the community in which it operates as well as the country as a whole. Using home produced fuel it presents no wartime seaborne supply problems and has a better chance of maintaining its ability to move in wartime. Æsthetically it is preferable to the noisy and fume-producing internal combustion engined vehicle and the fact that it does not contribute to atmospheric pollution has advantages to public health.

This brief examination seems to show that the trolley-bus has an excellent claim to consideration in any city's transport scheme. In that the examination proceeds from a belief that the trolley-bus has a case, and a good one at that, it may be thought to have bias. It must therefore be understood that the advantages set out exist in certain well-defined spheres of transport operation.

The trolley-bus system because of its high capital structure requires a medium to heavy passenger demand before its operating cost advantages can bear fruit. Being of its nature tied to the overhead it is essentially a trunk route vehicle and feeder systems into the trunk route are probably better operated by internal combustion buses if a transport undertaking is to keep down its fares.

An excellent case can be made on economic grounds for the internal combustion bus to operate feeder and connecting links of lower passenger density between trunks, and where through services start and finish in areas of lower passenger demand it may be necessary to use internal combustion buses even on routes that would otherwise require trolley-buses.

Ideal Vehicle for Many Cities

But there are many cities throughout the country and throughout the world with traffic-moving needs of the type for which the trolley-bus is the ideal vehicle, and clearly the trolley-bus is never likely to be dispossessed.

There will no doubt be many, who, appreciating that the major part of London's surface passenger moving needs are of this medium to high demand trunk route type, will ask why this decision to scrap capital equipment with much useful life and a most valuable type of transport vehicle, and to substitute oil buses at a cost which must approach £12 million, has been taken.

Industrial Electronics Convention

THE third post-war convention of the British Institution of Radio Engineers is being devoted exclusively to industrial electronics. The main theme is to show how electronics can increase qualitative and quantitative production, and production efficiency in all branches of industry. The convention will be held in the University of Oxford from 8th to 12th July and delegates will be resident in Christ Church.

Sir John Cockcroft, K.C.B., C.B.E., F.R.S. (Director of Research, A.E.R.E., Harwell), will deliver the Institution's Clerk Maxwell Memorial Lecture in the Clarendon Laboratory, Oxford, on Thursday, 8th July, at 8 p.m. In addition, over 30 papers will be presented during the five days of the convention, covering computors for industry and commerce, industrial X-ray equipment and the use of ultrasonics, nucleonic instrumentation, transducers in industrial production, and the various applications of electronics to process control.

After the opening of the convention by Mr. William E. Miller, M.A. (Cantab.), president of the Institution, the chair at Session 1, " Industrial Applications of Electronic Computors," will be taken by Mr. L. H. Bedford, O.B.E., M.A., B.Sc. (chief engineer, English Electric Co., Ltd., Luton). At Session 2, " Industrial Applications of X-rays and Sonics," the chairman will be Mr. H. G. Foster, M.Sc., M.Brit.I.R.E. (managing editor, *Electronic Engineering*), while at Session 3, " Nucleonic Instrumentation and Application," Mr. N. C. Robertson, C.M.G., M.B.E., M.Brit.I.R.E. (managing director, E. K. Cole, Ltd.), will preside. The chairman for Session 4, " Electronic Sensing Devices (Transducers)," will be Professor E. E. Zepler, Ph.D. (Professor of Electronics, University of Southampton), and at Session 5, " Process Control," Mr. J. L. Thompson (managing director, J. Langham Thompson, Ltd.). The chair at the final session on " Industrial Aids to Production " will be taken by Sir Walter Puckey.

A detailed programme and reservation forms may be obtained from the secretary, British Institution of Radio Engineers, 9, Bedford Square, London, W.C.1.

B.E.A.M.A. Report

In the review of the B.E.A.M.A. report in our last week's issue, the heading was printed incorrectly. The year should have read 1953–54.

British Industries Fair

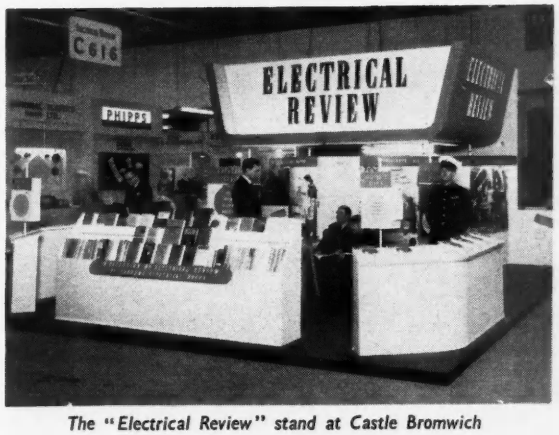
Twenty-eighth Display Opened in Birmingham and London

AFTER the usual feverish activity over the week-end all but a very few stands were fully completed in readiness for the opening of the 28th British Industries Fair at Castle Bromwich on Monday. The standard of displays appeared even better than in previous years, in some measure no doubt due to the availability of slightly more space. A considerable amount of new equipment can be seen for the first time.

Opening the Fair at a luncheon held on Monday, the Lord Mayor of Birmingham, Ald. G. H. W. Griffith, spoke of the great amount of effort from factories large and small which lay behind the enterprise and emphasized the tremendous field from which the exhibits came. The effects of the Fair were world wide and many distinguished visitors would be attending. Progress had been spectacular and he looked forward to even greater success in the future, but all in industry must be prepared to work still harder to maintain success. In conclusion the Lord Mayor proposed a toast to the Fair.

In reply, Mr. A. B. Waring, chairman of the Fair Management Committee, declared that this year's Fair was outstanding from the point of view both of exhibitors and visitors. They had had twenty-eight years of accumulated experience and no previous Fair was better displayed. The promoters of the Fair were not out for profit but the fact that the Birmingham Section had always shown a profit was an indication of its success. It had thrived on civic support and had received practical benefit from the City Council and various public service authorities. While it was a national Fair, it was nevertheless a great Birmingham achievement.

The Hon. James A. Dimmitt, Agent General for Western Australia, said that 8 to 10 million pounds' worth of work would be done for his country in the Midlands and about £75 million in the whole country. It was in Australia's national interest to place business in the Mother Country. Despite its endeavour to become self-supporting, Australia had always been loyal to British manufacturers and whenever it had to place business overseas would always give them preference. This loyalty had been still further strengthened by the recent visit of the Queen and the Duke of Edinburgh. He concluded by wishing the Fair every success.



The "Electrical Review" stand at Castle Bromwich

Mr. C. A. F. Hastilow, president of the Birmingham Chamber of Commerce, took the chair at the lunch and welcomed the representatives from Birmingham and the two overseas guests, Mr. Dimmitt and Mr. Marjoenani, the Chargé d'Affaires for Indonesia.

Mr. Peter Thorneycroft, President of the Board of Trade, presided at the customary dinner at the Mansion House on Monday evening. He said that next year's Fair would be held from 2nd to 13th May in London and Birmingham. Referring to the steady increase in exports since last July, he said that this indicated that there was not much wrong with our prices or designs.

Left: Cables for industry, building, transport and telecommunications provide the theme of the Cable Makers' Association's display. Right: Applications of electricity to finishing processes in various industries form the subject of a series of exhibits arranged by the E.D.A.

Power for Industry

ON looking round the electrical and engineering sections at Castle Bromwich, the general trend this year would appear to be that of providing industry, in the broadest sense of the word, with more power with which to perform its function. If British industry takes advantage of this power then obviously it can increase its productivity, which it must do if it is to retain its place in the increasingly competitive world markets.

Many overseas visitors to the B.I.F. have perhaps only a vague idea of the full capabilities of British engineers and a number of firms have this year staged their exhibits with this in mind. A good example is Standard Telephones & Cables, Ltd., which tells the story of its activities in the design, development and manufacture of telecommunication systems and equipment. As an instance of this " systems engineering " in action it shows some of the equipment used in connection with the Coronation broadcast. This includes a portable microwave radio television link, coaxial cables, microphones and loudspeakers, portable s.h.f. radio links, short wave broadcast transmitters and the PVIB portable automatic direction finding equipment. The latter was used to guide R.A.F. and R.C.A.F. pilots in the Coronation fly-past and is now the standard direction finding equipment for the R.A.F.

In a completely different, but nevertheless important, field of activity, the General Electric Co., Ltd., shows examples of its contribution to marine engineering and of equipment of all types for ships. Auxiliary electric power for ships is represented by a 550 kW geared turbo-alternator set built by Fraser & Chalmers. This set, complete on a combined baseplate, is of the type being supplied to Shell Tankers, Ltd. The turbine is a multi-stage impulse type machine running at 6,500 r.p.m., supplied with steam at 485 lb/sq in at the turbine stop valve at 790 deg F. The turbine is coupled through reduction gears to the three-phase 60 c/s 440 V drip-proof alternator, running at 1,200 r.p.m. The main exciter is direct coupled to the alternator through a solid half coupling, while vee ropes from an outboard-mounted grooved pulley drive the pilot exciter.

Underneath the turbine and directly mounted on the baseplate is a condenser of 1,100 sq ft cooling surface complete with air ejector to maintain a vacuum of 28·5in gauge when supplied with 1,250 gal/min of cooling water at 75 deg F. Capable of operating in sub-tropical conditions, the alternator has an overload rating of 25 per cent for two-hour periods.

Generating equipment of more direct interest to the industrialist is shown by Hampson Industries, Ltd., in the form of a range of inexpensive portable petrol engine driven battery charging plant with high-speed outputs ranging from 500 W to 1,500 W. These units are the result of a new approach to the problem and are claimed to be the first of their kind to be made in this country.

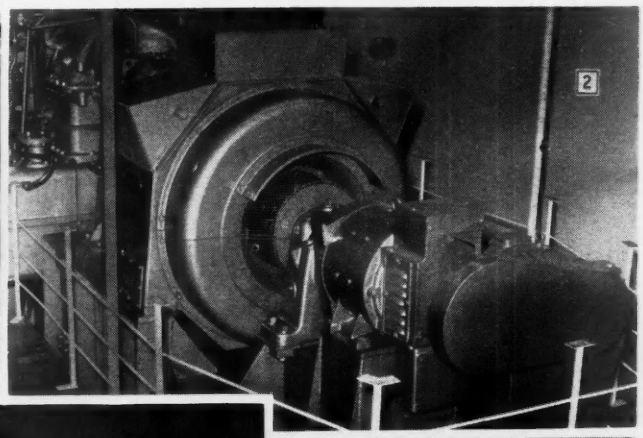
Static fully-float charging rectifiers are demonstrated by the Electric Construction Co., Ltd., together with a totally enclosed and pressure-ventilated electronically controlled Ward-Leonard drive for application to machines where extremely rapid speed control and speed response are required. Another interesting exhibit of this company is a 15 kVA motor-alternator set, comprising a self-excited, self-regulating alternator coupled to a totally enclosed squirrel-cage motor built to the new B.S. 2083:1954. The set is complete with automatic star-delta starter for the motor, together with the necessary control cubicle with electronic devices for the alternator.

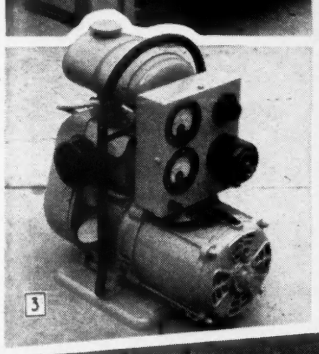
Diesel and petrol driven generating equipment is nowadays finding increasing use generally and a good example is the 500 W close coupled a.c. unit which is available from Auto Diesels, Ltd. The prime mover is a 1·25 b.h.p., 3,000 r.p.m. single cylinder petrol engine, while the screen protected 0·625 kVA alternator is a self-exciting, self-regulating, single bearing machine. The switchgear is built in and completely enclosed, and the weight of the unit, which measures only 18in long by 19½in high by 11in wide, is 88 lb. Equipment of the same rating and up to 40 kW is shown by Diesel Equipment, Ltd., together with a most interesting 1 kW unit, which is fitted with an air cooled diesel engine and has been specially designed for builders' and contractors' use. The gap at the lower end of the diesel generating plant range is now filled by units typified by the 1,250 W 230 V a.c. belt driven equipment shown by A. C. Morrison (Engineers), Ltd. It is powered by a Petter 2½ b.h.p. air cooled diesel engine and incorporates the company's " Remota " push button control system. Generators and motors for close coupling to small petrol engines in situations where mains supplies are not available are displayed by B.K.B. Electric Motors, Ltd.

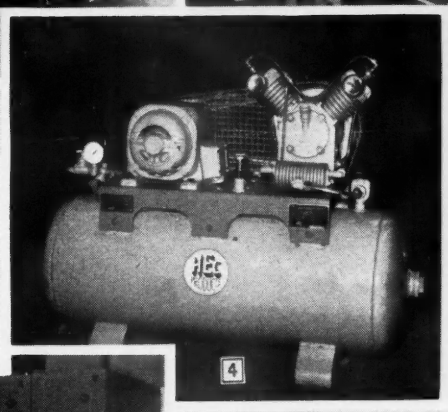
In many industries a.c. supplies only are available when d.c. is required or single-phase mains are available when a three-phase supply is required. Static equipment meeting these situations is shown by the Westinghouse Brake & Signal Co., Ltd., together with its new type 960 " Westruk " for hangar maintenance, apron servicing and aircraft engine starting. This transportable equipment can be easily moved by one man and provides 500 A d.c. continuously for hangar and apron services and a peak of up to 2,000 A for starting.

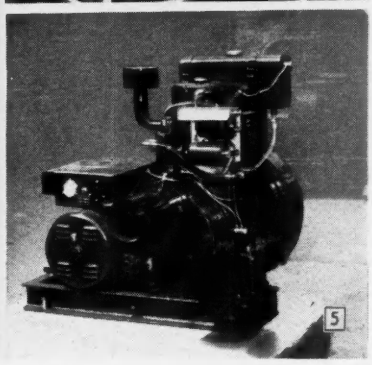
Electric power is not everything; hydraulic power or compressed air are often required in many industrial processes and a fair number of electrically operated equipments for both purposes are to be seen. A good example in this connection is the Greer-Mercier hydro-pneumatic accumulator shown by Finney Presses, Ltd., operating a 100/120 ton down-stroking press. The power pack comprises a 2 h.p. direct motor driven pump delivering 0·4 gal/min of oil at 5,000 lb/sq in. The pump is of the relaying type with automatic pressure control and coupled to a 4 gal Greer-Mercier accumulator enough hydraulic fluid can be stored during the cycle time to operate the press faster and more efficiently than could hitherto be done using a 5 h.p. motor and a pump of 3 gal/min capacity. Air compressors for all manner of duties are shown. A typical special purpose item of H.E.C. Compressors & Engines, Ltd., is a 5·2 cu ft/min 100 lb/sq in unit direct coupled to a ½ h.p. motor and the Hymatic Engineering Co., Ltd., have a range of mobile compressor sets with displacements varying from 9 to 50 cu ft/min and having volumetric efficiencies of over 90 per cent at pressures up to 100 lb/sq in.

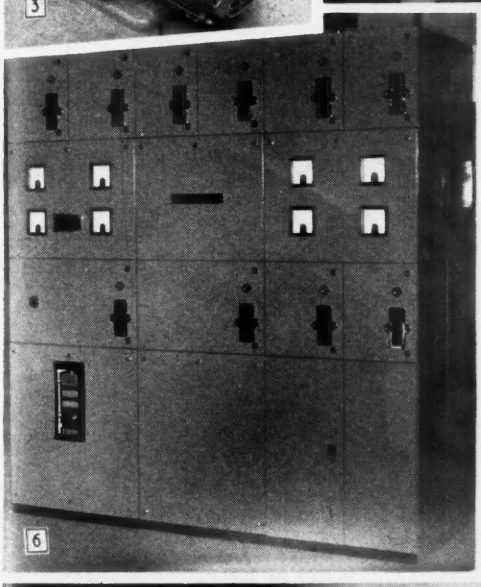
(1) Standard Telephones & Cables PVIB automatic direction finding equipment. (2) Fraser & Chalmers 550 kW geared turbo-alternator set. (3) Auto Diesels 500 W close coupled a.c. generating set. (4) H.E.C. Compressors 5·2 cu ft/min 100 lb/sq in compressor. (5) Morrison 1,250 W 230 V a.c. generating plant. (6) English Electric "Superform" switchboard. (7) Hampson Industries generating plant. (8) E.C.C. 15 kVA motor-alternator set. (9) Donovan special automatic control panels

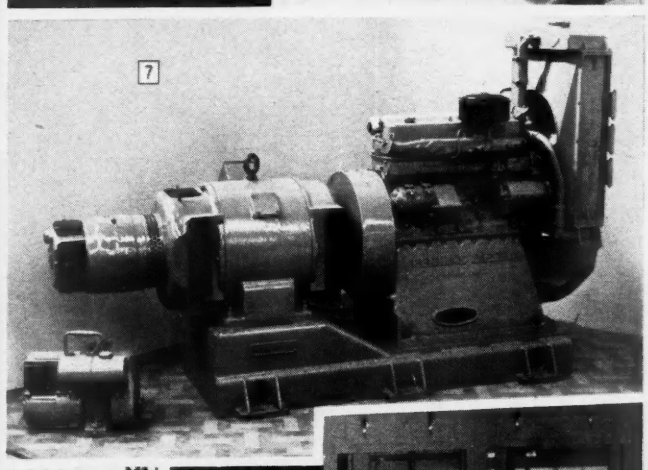


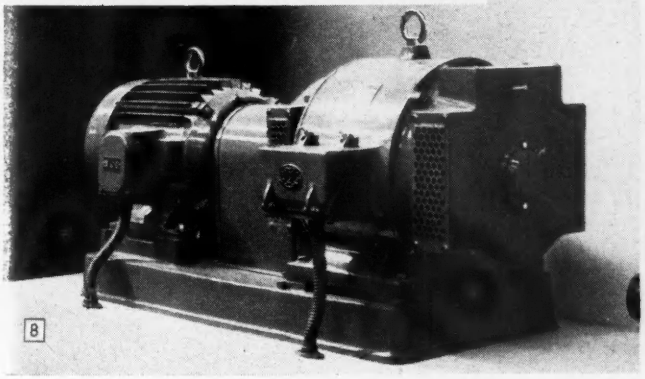


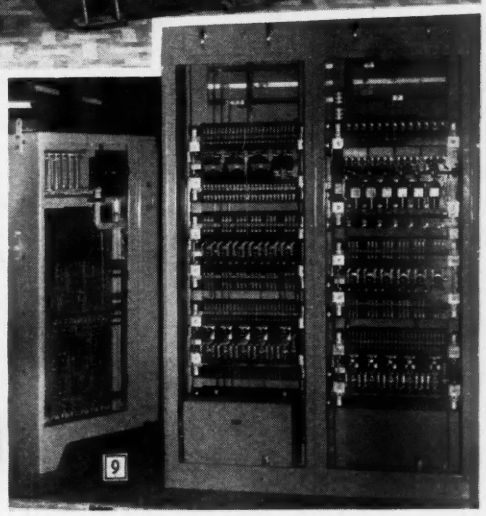












Control, distribution and switching must be efficiently done if the maximum advantage is to be taken of the available power. For instance, the English Electric Co., Ltd., shows how flexible are its " Superform " distribution boards and isolators. Other items for the same sort of work are flush type switchboards, an overhead busbar system, cartridge fuses and substation equipment.

The non-extensible h.v. ring main unit of the Yorkshire Switchgear & Engineering Co., Ltd., has been developed to meet the demand for inexpensive substation installations and the unit illustrated comprises two non-isolatable type " FM " fault making/load breaking oil switches and one automatic type " AFS " automatic fused oil switch. The arrangement is most flexible and the oil switch can be replaced by a 150/250 MVA oil circuit breaker in a few minutes. Bertram Thomas (Engineers), Ltd., have d.c. switchboards on view including one which is equipped with a type H.S.D. high speed circuit breaker. It is arranged for electrical operation and is equipped with automatic reclosure relay and associated equipment, the usual indicating instruments, back connections, etc.

An example of group motor control switchboard construction is shown by the Donovan Electrical Co., Ltd., with plug-in panels as used for interlocking control of the complete conveyor system in a modern high-productivity motor car factory. The same company has a control panel for a hot steel billet transporter for a " furnace to press " sequence requiring foolproof interlocking throughout.

Of course, in mines and in many industrial processes, flameproof switchgear is necessary and the increasing flexibility of operation of this type of equipment is emphasized by the exhibit of the Belmos Co., Ltd., which includes a new star-delta starter for motors up to 15 h.p. at 440 V and a two-unit switchboard showing coupled together a 200 A circuit breaker distribution unit and a 75 A direct-on motor starter.

Motors are now used in such large numbers and for such widely differing duties that they are accepted as standard items of equipment. However, it is only recently that a real attempt at standardization has been made. Higgs Motors, Ltd., illustrate this point with its new range of three-phase totally enclosed fan-cooled induction motors which are manufactured to dimensions complying with British Standard Draft Specification CN (ELE) 6814. These continuously rated machines are available either as slip-ring or squirrel-cage motors for all normal 50 c/s voltages Standardized drip-proof motors are also shown by Brook Motors, Ltd., as well as a 350 h.p. drip-proof machine of interesting design. It has an arrangement of loose louvres over the ventilation ports in each endshield, which can be rotated through 90 deg to afford drip-proof protection in any mounting position. The rotor is centrally mounted in the stator and the endshields are identical, so the rotor can be reversed if connections are required from the other side.

Many special purpose motors are to be seen and among these is the new F.H.5 permanent capacitor type geared motor for low speeds shown by Hillman Electric Motors, Ltd. It is die cast in aluminium with an interchangeable gearbox which moves through 360 deg and provides speeds of from 1 r.p.h. to 600 r.p.m. Two new geared units are shown by Fractional H.P. Motors, Ltd. The C70 provides 250 lb-in torque at 0·25 r.p.m. and varying speeds up to 12 r.p.m. at 200 lb-in torque, while the D60 gives 15 lb-in torque at 0·3 r.p.m. in varying speeds up to 0·88 r.p.m. at 15 lb-in torque.

Countless motors are to-day built in as an integral part of the equipment concerned such as in the many portable tools shown by Wolf Electric Tools, Ltd. A new item here is a precision heavy-duty valve refacer for any type of engine (petrol or diesel) on all cars and commercial. It is available with universal motors for operation on 100 V to 250 V mains and also on 50 V to special order. On the stand of the Rawlplug Co., Ltd., is an attachment which when fitted to an electric drill converts its rotary motion to a percussive action, each revolution producing a blow. Any type of electric drill which has a working speed of up to 2,000 r.p.m. and a minimum ¼in chuck can be used.

Other motorized tools are the conduit benders of Hilmor, Ltd. Here the rotary hydraulic No. 3 is a completely portable machine which is speedy and light in action and requires the minimum of manual effort to operate. It has a maximum capacity of 2in light and heavy gauge conduit and it can also be tooled to bend gas and steam barrel, light gauge copper and steel tube up to 2in dia.

Arc welding machines are to be seen in great profusion on one or two stands. It goes without saying that welding contributes to higher productivity in a really big way by making intelligent use of available power. This point is brought home by the type PA.50/150 multiple projection and cross wire welding machine demonstrated by Sciaky Electric Welding Machines, Ltd. It has been developed for making a large number of welds on a wire mesh simultaneously, both in the square and in line, and is arranged for automatic continuous feed-in to each line. It is, however, not confined to a single line of welds; several lines can be made with each travel movement, this depending on the number of welds per line and the gauge of wire. The speed of operation is about sixty feed-in movements per minute.

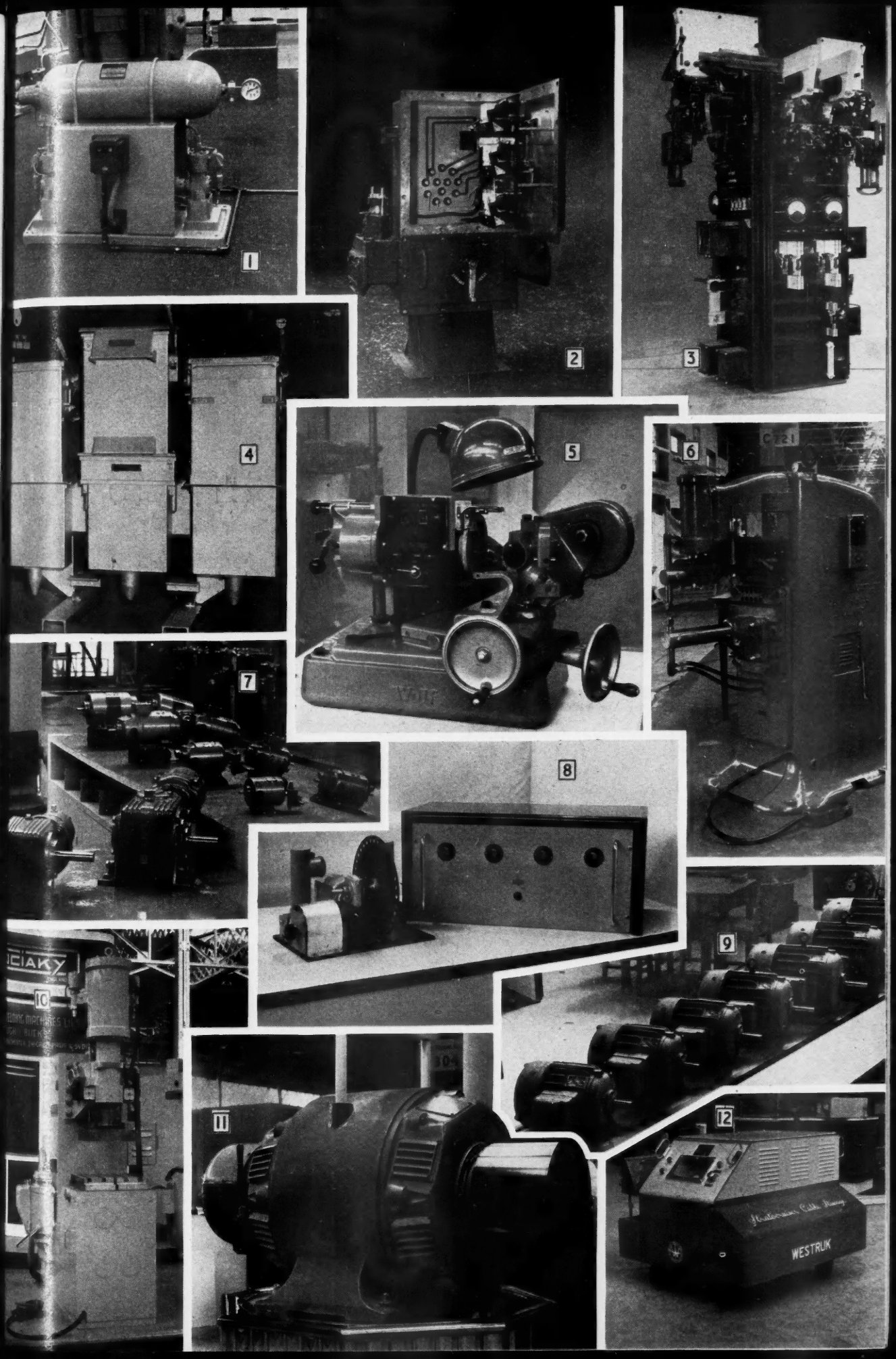
Holden & Hunt, Ltd., have automatic wire butt welding machines from 3 to 30 kVA capacity, which are demonstrated with alternative forms of clamping control. These will no doubt be of interest to both ferrous and non-ferrous wire mill managements. The same firm also has a comprehensive range of foot-operated spot welders with capacities from 5 to 25 kVA and having various arm " set-ups." A demonstration is given of one of these machines operating in conjunction with a B.T.H. thyratron timer.

Another interesting tool is the power hacksaw of W. Kennedy, Ltd., which at £21 is claimed to be the lowest-priced portable power saw in the world. It is driven by a ⅙ h.p. 240 V split-phase 50 c/s Hoover motor and is designed to cut a 0·010in slice. It cuts light-gauge tubes and sections as efficiently as solids.

Coil winders are essential machines in the light electrical and telecommunications industries and a particularly interesting example is the " Edinburgh " automatic wave winding units of Nevilles (Liverpool), Ltd., which will wind up to four or more coils simultaneously. The wire feed is quickly adjustable and easily detachable for progressive winding and two ranges of spindle speeds are available with interchangeable cone pulleys.

Materials handling equipment probably contributes more towards higher productivity and increased industrial efficiency than anything else and it is surprising that the

(1) Greer-Mercier hydro-pneumatic accumulator power pack. (2) Belmos flameproof 3-phase automatic star-delta starter. (3) Bertram Thomas switchboard incorporating type H.S.D. high-speed d.c. circuit breakers. (4) Yorkshire Switchgear non-extensible h.v. switchgear. (5) Wolf heavy-duty precision valve refacer. (6) Holden & Hunt foot operated spot welder. (7) Geared motors by Fractional H.P. Motors, Ltd. (8) Londex photo-electric high speed counter. (9) Higgs standardized fan-cooled totally enclosed motors. (10) Sciaky PA50/150 multiple projection and cross wire welder. (11) 350 h.p. Brook drip-proof motor. (12) Westinghouse type 960 " Westruk "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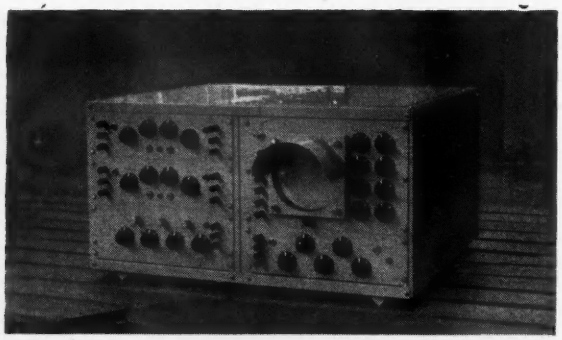
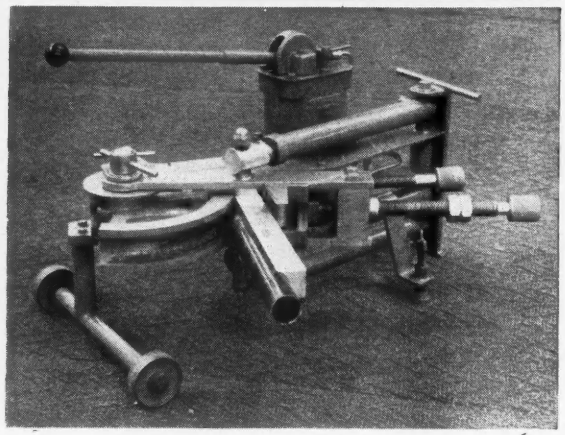




Hilmor hydraulic conduit bender and (above) Southern Instruments four-channel oscillograph

electrical power requirements for such equipment are so low. Obviously a wide diversity of materials handling plant is on view at Birmingham. Amongst this varied array is the new " Select-O-Load " lifting magnet control system of Electromagnets, Ltd., which greatly increases the degree of control available over the amount of material picked up or dropped by a lifting magnet. Full control is available to the crane operator from zero to full lift without using wasteful series resistances.

The reclamation of tins and other ferrous content from household refuse is still of considerable value to the national economy and this has prompted Rapid Magnetic Machines, Ltd., to show its overband extractor which is being used in salvage departments all over the world. A smaller version of this equipment is suitable for use in mechanized foundries.

Still in the field of materials handing, but liquids this time, is the deep well turbo jet pump of Morrison Automatic Pumps, Ltd. It operates on the principle of a turbine pump actually on the surface of the ground, and a stationary jet (operated by water from the by-pass of the pump). The jet can be anything up to 450ft below ground and as there are no moving parts the only equipment which requires maintenance is above ground where it can easily be got at.

Moving now to industrial electric vehicles, the fork lift truck is perhaps one of the most useful savers of man power and time in the factory. Typical of these machines is the 2,000 lb three-wheel model shown by Conveyancer Fork Trucks, Ltd. It has a 9ft mast and incorporates full free lift which permits elevation of the load without extension of the mast. The batteries are easily accessible and of large capacity, thereby enabling long shifts to be worked without recharging. Three types of electric fork lift trucks are shown by Ransomes, Sims & Jefferies, Ltd., the F.L.10, capable of lifting 10 cwt, F.L.30 capable of lifting 30 cwt, and the F.L.40 capable of lifting 2 tons.

On the stand of Westool, Ltd., are Warner electric motion control brakes, clutches and clutch couplings, for the first time shown and manufactured in this country; they have previously been obtainable only from the United States. This is claimed to be the most efficient method of starting and stopping an automatic process in the minimum of time, gently, and with the smallest loss of energy. The exhibit shows the Warner brake and clutch under simulated working conditions, for both manual and automatic control.

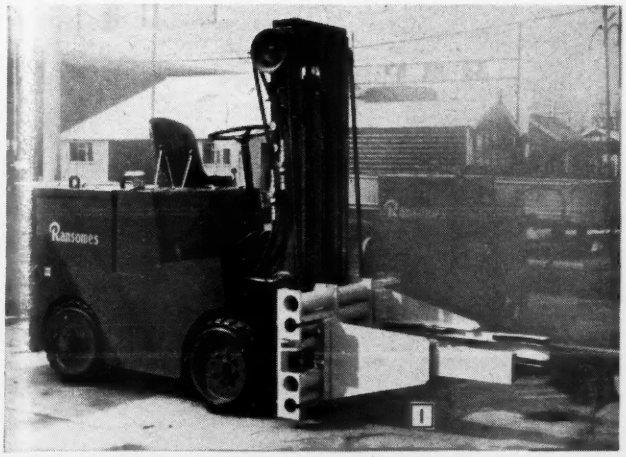
Electrically operated hoists are also to be seen in large numbers on the stands of such firms as Felco Hoists, Ltd., and Lifting Equipment, Ltd., while Legg Industries, Ltd., show battery charging equipment employing metal rectification for all types of electric vehicles and trucks. To meet situations where it is necessary for vehicle battery chargers to operate in humid or fume laden atmospheres, the last-named has evolved an oil-cooled equipment. Both the transformer and the rectifier are fully protected, the leads being brought out from the tank to the control box.

Among instruments for measuring and controlling industrial processes, perhaps the commonest device is the counter, which can be operated by pulses produced photo-electrically by interrupting a beam of light shining on to a photo-cell or mechanically by means of contacts—for example, a micro-switch. An electronic instrument capable of operating from both these pulse sources is shown by Londex, Ltd., the basic circuit of which comprises a pulse shaping circuit and d.c. amplifier followed by cold cathode trigger tubes and decade counter tubes. The standard model, which has a total consumption of less than 100 W, is suitable for counting at speeds up to 200 per second, which is adequate for most industrial purposes. Higher speeds are attainable on alternative models.

On the control side the Industrial Pyrometer Co., Ltd., demonstrates a simple and inexpensive equipment for the control of small gas-fired plant such as furnaces and ovens. It indicates simultaneously the furnace temperature and rate of heat supply with easy and precise means of adjustment, so it is far superior to the haphazard method of fitting hand valves, often without indication of gas pressure being supplied to the plant, or the governing of pressure to prevent upset from supply changes. In a similar connection the Rheostatic Co., Ltd., features primary firing controls for automatic boilers, mechanical stokers, and oil and gas burners. Associated with these controls are a number of protective devices for gas and oil firing, including photo-cell electronic flame failure equipment for oil burners. The same firm also has " Service " and " Satchwell " resistors, which are used principally for controlling traction and industrial motors, and for neutral earthing and loading.

Electronically operated instruments for temperature measurement and control are displayed by Ether, Ltd., including the Ether-Wheelco temperature controller, a wide chart potentiometer recorder and the " Thermal-tro " electronic temperature controller. This new instrument operates on the Wheatstone bridge principle and is shown

(1) *Ransomes FL40 two ton capacity fork lift truck.* **(2)** *Westool " Warner " control brakes and clutches.* **(3)** *Conveyancer E2-20/3W 2,000 lb fork lift truck.* **(4)** *Rapid Magnetic Machines magnetic ore separator.* **(5)** *General view of insulators on the Royal Doulton stand.* **(6)** *Lifting magnet with " Select-O-Load " control system by Electromagnets, Ltd.* **(7)** *Rheostatic motorized valves*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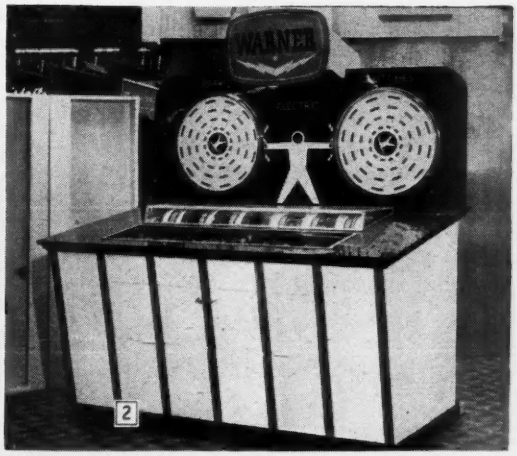
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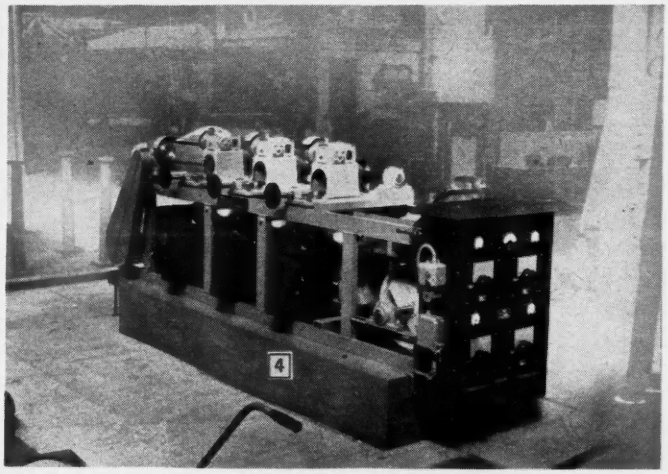
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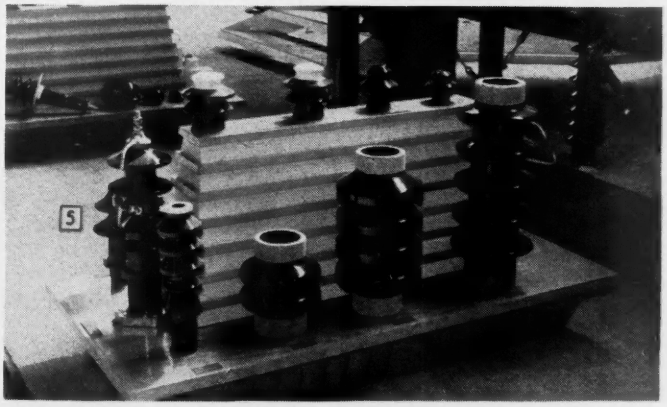
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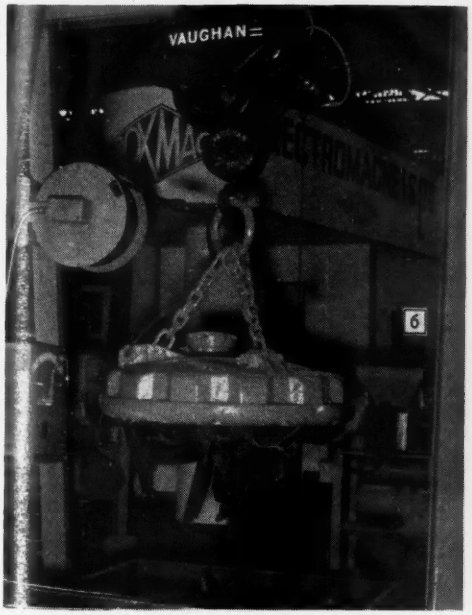
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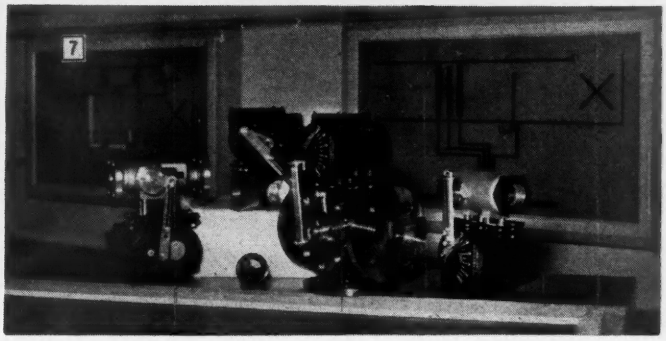
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Oldham hydrogen lamp

with its detachable electronic unit, which takes the place of the galvanometer formerly used. Mains operated synchronous clocks and master clock controlled types are shown by Gent & Co., Ltd., together with the latest electronic chiming and striking equipment, and an automatic one-hand-operated time recorder and programme instrument for sounding start and cease work signals.

Another electronic instrument typifying equipment in the same category is the general purpose cathode-ray oscillograph of Southern Instruments, Ltd. It uses a four gun cathode-ray tube and has four direct-coupled driver amplifiers, a time base and time marker oscillator, the necessary power panels being contained in a separate unit. The complexity of present developments in marine, aircraft and communication frequently necessitates the detailed study of several simultaneous events so the major attraction of such an instrument, with a multi-gun tube, is its ability to give a visual display of simultaneous superimposed waveforms on a common time base.

Turning now to lighting there is on the stand of Oldham & Son, Ltd., the type " GW-H " cap lamp which carries the first approval certificate for use in hydrogen to be issued for any cap lamp, and the first approval certificate for use in hydrogen to be issued for any electric lamp of any kind under the more stringent post-war testing regulations. This and other modern industrial lamps are contrasted with a collection of lights that have made industrial history over the past century. Lighting equipment for motor vehicles shown by C.A.V., Ltd., includes the new large diameter rear lamps introduced to improve safety of night operation; these have 3½in diameter openings and are fitted with twin bulbs in parallel to act as a safeguard in case of bulb breakage. Headlamps are arranged for double dipping, with pre-focused bulbs for accurate setting, and with the " block " lens, the various prisms of which direct the light to prevent dazzle and provide a flat-topped beam. As would be expected, Joseph Lucas, Ltd., have a wide range of electrical equipment and accessories for cars, motor-cycles, cycles and for marine and agricultural and stationary engines.

The stand of the Royal Doulton Potteries uses in its construction all types of electrical porcelain insulators to demonstrate the general mechanical functions they perform in service. Four stacks of 132 kV heavy duty post insulators form the supports for the roof of the stand, from which a raised platform is hung 2ft 9in above floor level by five strings of 132 kV and 275 kV overhead line suspension insulators. An exhibit here of particular interest to circuit breaker designers is the blast tube used for the construction of the 275 kV circuit breaker; this is produced in one piece and is subject to a routine pressure of 1,000 lb/sq in. In addition to high voltage cable sealing end and surge divertor housings, there are lower voltage insulators, including bushings with flanges capable of giving oil-tight joints with unground surfaces.

The plastics produced by Bakelite, Ltd., include laminated sheet, tube and rod, which are widely used in the electrical industry for punchings, terminal plates, conduits, etc. Grades are available based on paper, fabric for greater strength, asbestos for heat resistance, and glass fabric bonded with a variety of resins. The " Vybak " range of p.v.c. compounds includes extrusion and moulding compounds, and rigid and elastomeric sheet. A display of corrosion resistant fans and ducting demonstrates typical applications for a newly developed grade of rigid industrial sheet.

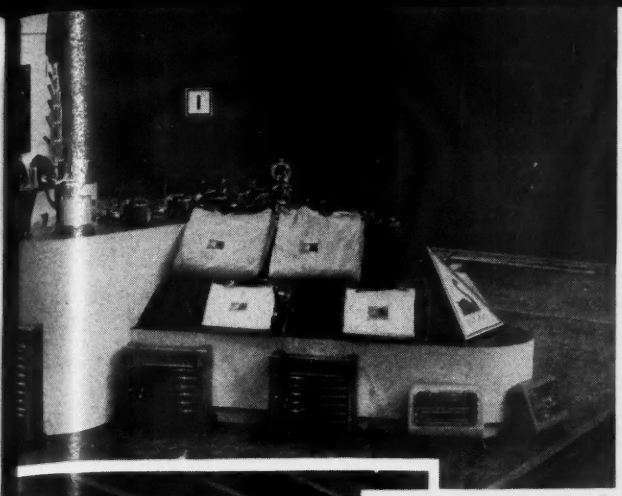
The exhibit of Monsanto Chemicals, Ltd., shows the " Aroclors " as capacitor impregnants, demonstrating the reduced capacitor size which these products make possible. They are also featured as fire resistant heat-transfer media for the engineering industry. The " Pyroclor " display illustrates the advantages of this material as a transformer fluid of high fire resistance permitting the location of transformers close to plant and without the protection of special buildings.

Apparatus for the Home

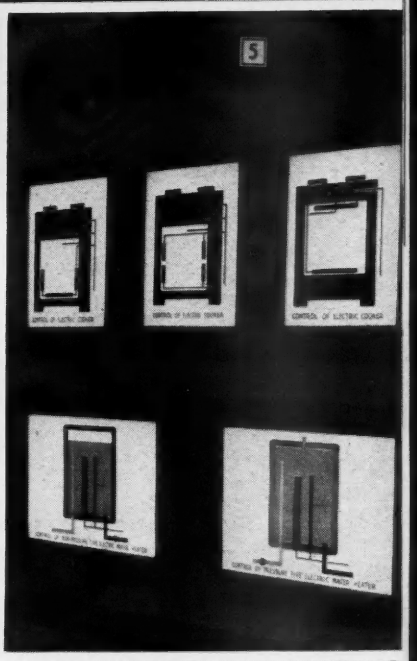
Turning now to domestic apparatus it is perhaps somewhat surprising that the equipment in which there seems to have been the greatest development should have been one which is handicapped most by the imposition of a high rate of purchase tax. That the number of new space heating appliances should be so considerable is by no means due only to the necessity to conform to the new regulations regarding guards, though this obviously must have had some effect on the situation, and it is apparent that, despite the strong publicity campaign that has for some years been carried out in favour of other methods of heating, the public is not going to be distracted from its preference for electricity as a means of short-period, even if not complete, warming of the home.

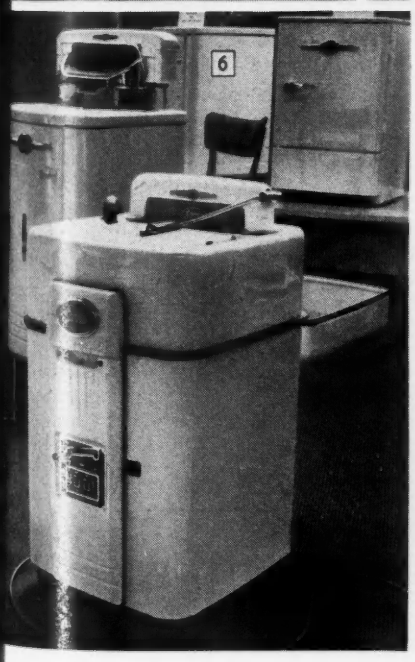
An extended range of Bulpitt fires includes the 1 kW and 2 kW " Woodstock " models which make a virtue rather than a necessity of the new B.S. requirements and incorporate the new type of guards as an integral feature. In the redesigning of their six 3 kW period fires to conform to the new specifications Berry's Electric, Ltd., have achieved an improved appearance by concealing the elements from view and relying on reflectors to direct the heat where required. This same principle has been incorporated in the new " Alderberry " 2 kW log fire which is designed to fit into, and completely hide, the usual grate recess of a solid fuel fire. A novel feature now embodied in all these imitation fuel fires is the switching arrangement whereby the concealed control knobs actually form part of the fuel effect. Another Berry development is the addition of wall mounting and industrial models to the range of " Raydair " background

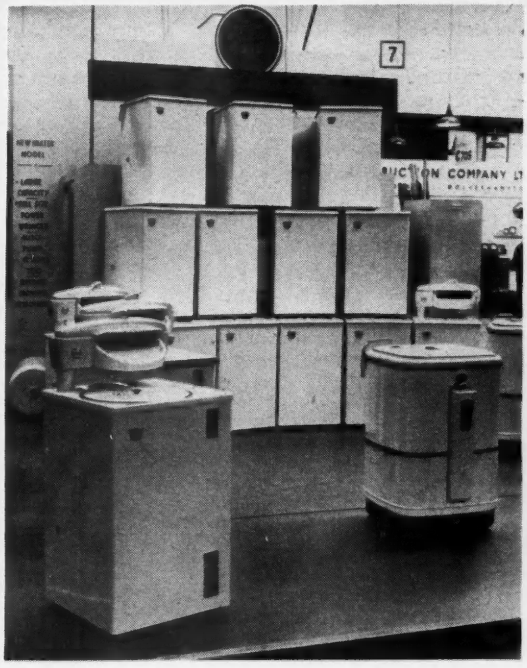
(1) Blankets and heating pads are a prominent feature of the Bulpitt display which also includes the two new " Woodstock " fires. (2) A selection of Phœnix floor cleaning apparatus. (3) Berry display including new contemporary lighting fittings and redesigned period imitation fuel fire. (4) Adaptation of a Revo " Monarch " cooker forming part of a display of " English Rose " built-in kitchen equipment. (5) Illuminated panels showing methods of cooker and water heater control (Rheostatic). (6) The " Servis " model " S " washer boils, washes, wrings and empties. (7) Thor Appliances are now marketing H. Fisher (Oldham) washing machines in this country. (8) " Freshel " vegetable, fruit, etc., freshening apparatus (C.E.A.)

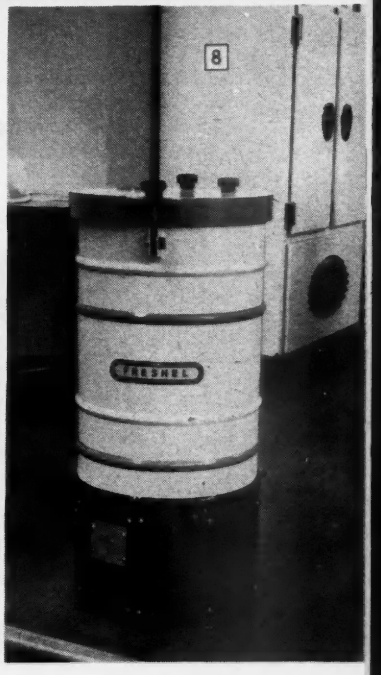


PHŒNIX DOMESTIC ELECTRICAL APPLIANCES





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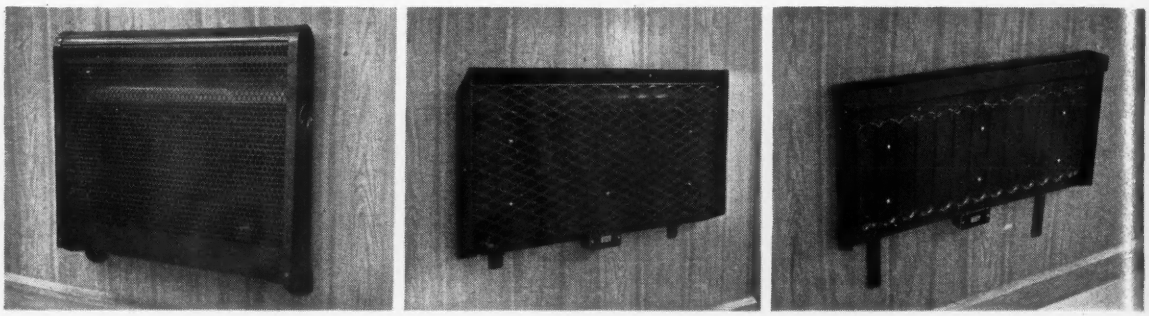


Three new Berry " Raydair " heaters for wall mounting, industrial and greenhouse use

heaters: there is also a greenhouse type incorporating a water trough.

Both better appearance and quicker production are obtained by the use of one-piece pressings for some of the larger Dimplex oil-filled radiators. To cut down still further the effect of the proximity of the radiator, a new type of thermostat with increased air ventilation is now being incorporated in all models. At no extra charge a new colour, pink, is also now available in addition to bronze, white, silver grey, eau de nil, sky blue, cream and gold.

In addition to their standard convector Carter & Co. (Nelson), Ltd., introduce a new 1 kW inset unit available in a variety of colours. Its safety features render it particularly suitable for use in schools, shops, hospitals, nurseries, etc. Production of the " Deren " convectors formerly made by De Renzi Holmes & Co., Ltd., has been taken over by V. G. Howell & Co., Ltd., who are showing both the 1 kW and 2 kW models as well as the " Deren " automatic toaster.

Safety has also been one of the main considerations in the design of new portable sheet metal fires introduced by L. G. Hawkins & Co., Ltd., it being practically impossible to knock them over. They are available with either 1 kW or 2 kW loadings and are finished in mushroom colour with chromium reflectors. Three new " Mysto " fires made by W. T. French & Son, Ltd., have novel features. One 2 kW cylinder shaped model somewhat reminiscent of a birdcage has the appropriate name of the " Linnet," the elements presumably representing the bird. Both the other types have exceptionally wide-angle parabolic reflectors. The more straightforward model with two 1 kW elements is called the " Countess ": the other, the " Mystovector," is so designed that air passing over the back of the reflector is utilized to give a certain amount of convected heat. All three fires are available in a choice of sprayed bronze, silver and metallic blue finishes.

Another interesting development in the heating field is a convertor unit produced by the Cradley Foundry & Engineering Co., for use with its " Kozi-toes " all-night solid fuel fire. Designed to replace the draught control, this device immediately converts the fire to electrical operation for summer use. It is virtually impossible to use the electrical unit while the solid fuel fire is alight.

Home laundry equipment is again fairly well represented this year and apart from already well known products there are a number of innovations. To accompany their " Servis " de luxe heated or unheated machine already successfully established in over fifty countries, Wilkins & Mitchell, Ltd., show the new model " S " machine designed specially for the smaller kitchen and incorporating 2 kW heating elements and an automatic pump. Its tilted turbulator, which can be removed for cleaning underneath, imparts an offset vortex action to the water. The machine has been designed to withstand both tropical and arctic conditions and is already being exported in large quantities.

Thor Appliances, Ltd., have now taken over all the home sales of H. Fisher (Oldham) washing machines and as a result certain changes have been made in the models available. Production of the Thor " Automagic " combined clothes and dish washer still continues but the " Stowaway " model has been withdrawn, its place being taken by a modified version of the Fisher " E.R." Renamed the " 54H," this machine is slightly taller, takes 8 lb of dry clothes and is fitted with heating elements as standard. The 7 lb capacity model " L," without pump or heater, will also be available. For the home market all machines will in future be finished in white.

Both domestic and commercial " Launderette " type washing machines are shown by Bendix Home Appliances, Ltd., the former embodying the " water rationer " device and the latter an indicator to show when it is time to put in the soap. In addition a hydro-extractor is demonstrated. Among the Amplec wash-boilers is the new 200 model available with or without a safety cut-out. It has a 10 gal capacity and is controlled by a 3-heat switch. Both the tub and the top, which is available with either removable circular or " D " shaped lid, are aluminium, the exterior being galvanized.

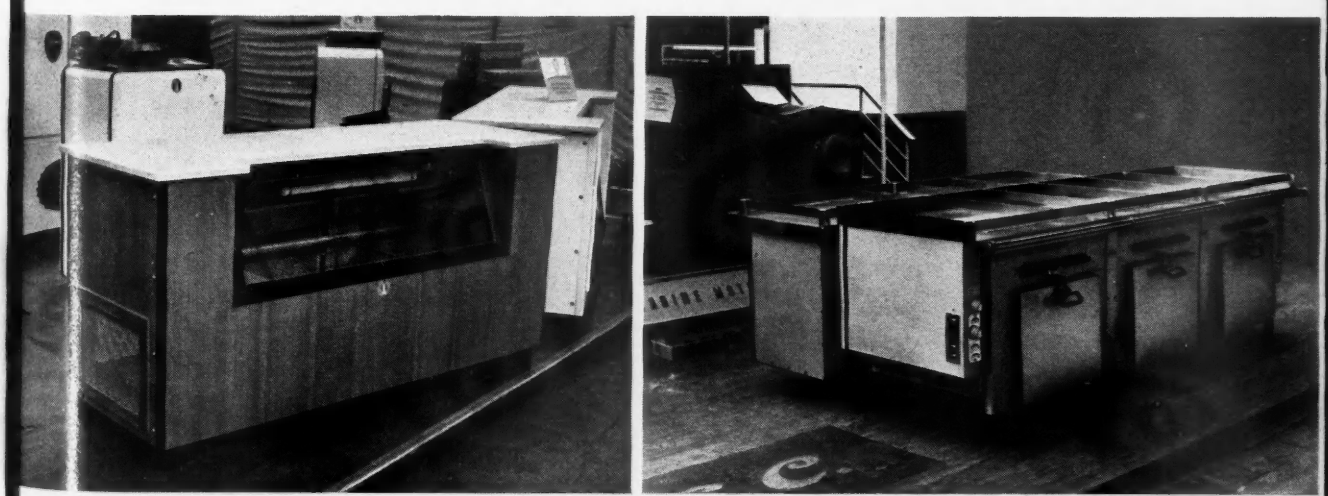
Water heating is somewhat sparsely represented. The new competitively priced immersion heaters in seven different lengths are to be seen on Berry's stand, with the 1½ gal and 2½ gal " New Look " flat-backed flush fitting water heaters available in four colours, while both automatic and non-automatic immersion heaters accompany the " Hotway " rapid water heaters demonstrated by the Campbell Engineering Co., Ltd. A full range of elements for immersion heaters as well as for other purposes is shown by George Bray & Co., Ltd. A display of illuminated panels by the Rheostatic Co., Ltd., effectively demonstrates the methods of controlling both pressure and non-pressure type water heaters as well as cookers. In addition to stem and capillary tube thermostats this company also shows clamp-on type units which are finding increasing applications both at home and abroad.

Apart from the marine type range shown by the General Electric Co., Ltd., only one full-sized cooker is to be seen and this forms part of a display of " English Rose " built-in kitchen equipment shown by C.S.A. Industries, Ltd. An adaptation of the Revo " Monarch " apparatus, it has both the control panel and the grill at eye level, with the oven at waist height. Both heated drawer and storage cupboard are provided, while the hob unit, which can be placed at either side of the oven, has four boiling plates recessed into a rectangular cast iron hob plate with mottled enamel finish. The only other cooking apparatus

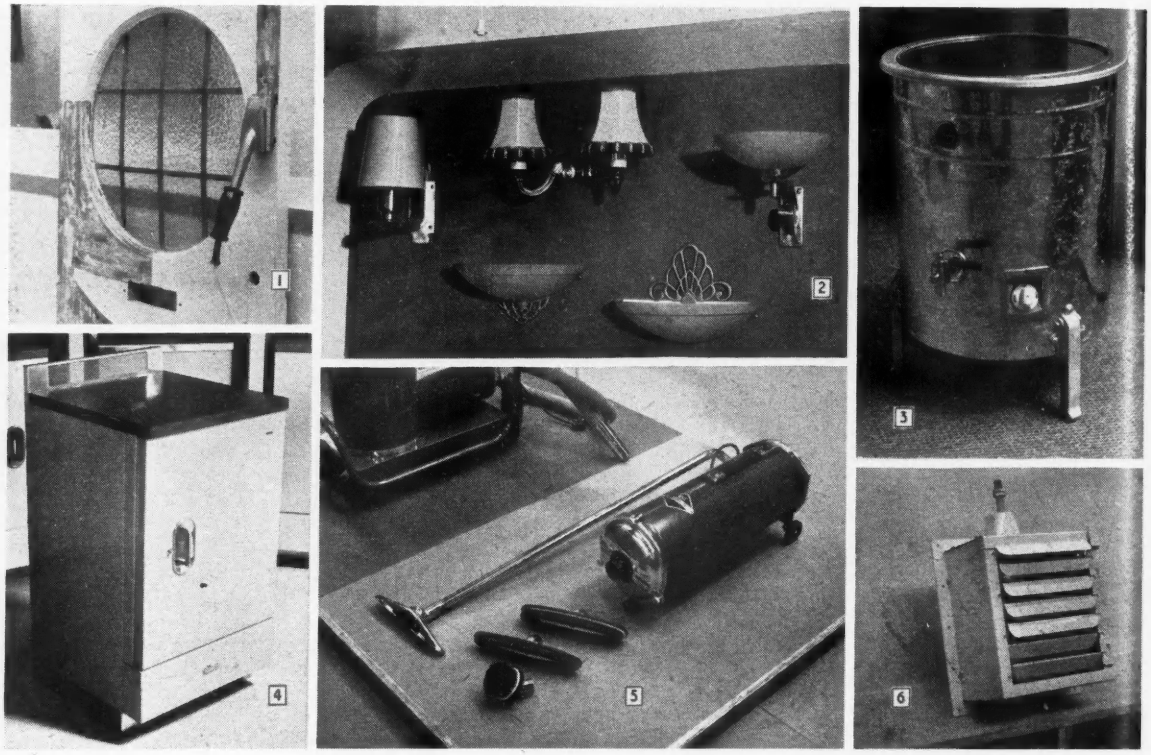
(1) *Dimplex 750 W oil filled radiator in the new pink finish, with double towel rail and new thermostat incorporated.* **(2)** *V. G. Howell "Deren" 1 kW convector and automatic toaster.* **(3)** *W. T. French "Mysto" fires: The "Linnet," the "Countess" and the "Mysto-vector."* **(4)** *Cradley unit for converting the "Kozi-toes" solid fuel fire to electrical operation for summer use.* **(5)** *Berry "Alderberry" fire.* **(6)** *L. G. Hawkins 2 kW reflector fire.* **(7)** *W. T. French "Mysto" boiling ring, coffee percolator, kettle and iron*

shown is the L. G. Hawkins "Ovenette" which, though measuring only 14in dia and 8in high and having a loading of only 800 W, can effectively roast, bake and grill up to 8 lb of food at a time. The new "Turn-Easy" toaster also shown by L. G. Hawkins & Co., Ltd., has been designed with a particular view to simplicity: all metal parts are chromium plated, the handles and feet being of black "Bakelite."

Following the lifting of the restrictions on the use of nickel about a year ago, chromium plating is now back in full use for small appliances. A particularly wide range of "Swan Brand" equipment so finished is to be seen on the stand of Bulpitt & Sons, Ltd., who incidentally are drawing special attention to one of their not-so-well-known lines, electric blankets and heating pads. Here, too, can be seen a modified design of the company's 2-pint polished aluminium percolator with extra large coffee container. A new 1½-pint chromium plated percolator is among new



C.E.A. half vision refrigerated display counter and G.E.C. marine type cooking range



(1) *Osborn paint stripper.* **(2)** *One of the new period wall brackets is to be seen in the top centre of this display of William McGeoch lighting fittings.* **(3)** *Amplec "200" wash boiler.* **(4)** *C.S.A. "English Rose" refrigerator.* **(5)** *B.V.C. model "TL.1" light industrial vacuum cleaner as used on the Royal Yacht "Britannia."* **(6)** *Carter unit heater*

products of W. T. French & Co., Ltd., which also include a whistling kettle, a combined boiling ring and toaster, a non-automatic iron and electric fencers. The last-mentioned item, a completely new development, is available in two types, agricultural and a special unit for keeping away stray cattle around caravan sites.

The recent commissioning of the new royal yacht *Britannia* lends particular interest to the B.V.C. model "TL.1" light industrial vacuum cleaner, several of which are in use aboard. Among other industrial and commercial floor maintenance equipment Columbus-Dixon, Ltd., have apparatus for scrubbing and drying all types of floor, as well as for carpet shampooing and polish spreading. With the new Phœnix "Power-Flo" and "Jet-Power" vacuum cleaners, which have ½ h.p. motors, is a new floor polisher incorporating two revolving and one stationary brushes.

Somewhat less refrigeration equipment is to be seen this year. Wilkins & Mitchell, Ltd., again show their 3·2 cu ft and 7·6 cu ft models, while C.S.A. Industries, Ltd., introduce a new 3 cu ft "English Rose" model incorporating a G.E.C. sealed unit and available in a wide range of finishes to match any desired colour scheme. Among the commercial equipment is a new 6ft by 2ft by 3ft half-vision display counter made by C.E.A. (Distribution), Ltd. This incorporates an hermetically sealed unit and has its side panel completely removable for fitting or major overhauls.

Another C.E.A. development which appears to have a promising future is the "Freshel" machine for the use of greengrocers for freshening up vegetables, fruit, etc. Incorporating a vacuum pump it has as its object the removal of air absorbed by the vegetables, etc., and its replacement by water. Demonstrations on cabbage, lettuce, rhubarb, etc., show a remarkable reviving effect, the whole operation taking only 1–2 minutes. The model "B.3" machine shown can deal with 30 lb of vegetables at a time.

On the lighting side Berry's Electric, Ltd., enter the contemporary design field with about a dozen different models, mostly incorporating conical buckram shades. Multi-coloured bowls of striking modern design include a nursery model with an animal motif. Embellished rods are another feature of a new range of bowl pendants. New lacquered brass and bronze period fittings by William McGeoch & Co., Ltd., include three and five light pendants (designed for either upward or downward mounting of the lamps) and single and two light wall brackets to match. Novel combinations of decorative glassware and metalwork give distinction to a wide range of lighting fittings displayed by Wyngate Smith, Ltd.

For the home handiman Wolf Electric Tools, Ltd., has further extended the usefulness of the "Wolf Cub" equipment by making available a fretsaw attachment. A new paint stripper made by the Osborn Manufacturing Co., Ltd., can conveniently be used with one hand only. It has an aluminium body and a stainless steel blade and is loaded at 750 W.

Displays in London

One of the most interesting features of the London Sections is the Design Centre arranged by the Council of Industrial Design at Earls Court. Representing a selection from the Council's record of about 5,000 well designed goods in current production, this display comprises about 350 items attractively set out. Among the electrical items chosen are an English Electric automatic cooker, G.E.C.

and Bulpitt kettles, a G.E.C. boiling plate, an L. G. Hawkins tea maker, an Easipower toaster, a Bratt Colbran hotplate, a Thermovent space heater, Electrolux and "English Rose" refrigerators, a Kenwood food mixer, an Electrolux vacuum cleaner, Fillerys combined vacuum cleaner and floor polisher, a Campbell instantaneous water heater, Fisher and Easiclene washing machines, Revo and G.E.C. irons, General Signal & Time Systems and Baume & Co.'s clocks.

Council-approved lighting fittings include models by the G.E.C., H. C. Hiscock, Ltd., Oswald Hollman and George Forrest & Sons, Ltd. In all cases emphasis is placed on apparatus which combines technical efficiency with simplicity of appearance and smooth, streamlined surfaces which are easy to keep clean.

Electricity also plays a conspicuous part in two other special exhibits, one at Earls Court dealing with the conquest of Everest and the other at Olympia paying tribute to the British North Greenland Expedition. Pye, Ltd., and Vidor, Ltd., are among the thirty or so manufacturers who by supplying scientific, radio, etc., apparatus helped to make these two enterprises possible.

Among the exhibits of individual manufacturers at Olympia there are the customary extensive displays of lighting fittings and clocks and associated with the latter are various office and industrial instruments such as time recorders, staff location equipment, counting and numbering instruments, duplicators and telephones.

A comprehensive display of domestic electrical appliances by Pifco, Ltd., includes electric blankets shown for the first time. New safety bedside switches are incorporated in other blankets exhibited by Warmex, Ltd. With its "Buk" and "Kub" shavers Chilton Electric Products, Ltd., shows a re-designed universal shaver socket suitable for all types of British, American and Continental plugs. Perihel, Ltd., specializes in electro-medical infra-red lamps. An electric tooth brush is a novelty introduced by Savant Laboratories, Ltd.

A slider type automatic voltage regulator and an electronic constant voltage transformer are new products among a number of special purpose transformers shown by Foster Transformers, Ltd. Precision switches for a wide range of electrical appliances are a feature of the Castelco display, particular attention being drawn to coloured switches for table lamps, floor standards, etc. At Earls Court the number of exhibitors of vacuum cleaners has dwindled to three but in the textile section can be seen a number of electrical items such as sewing machines, cloth cutters, etc. The new English Electric EA83 refrigerator is shown in the kitchen of the Burgess house, and the company's automatic cooker is to be seen in the model house designed for Neata Products.

Single-Phase Traction at 50 Cycles

TWO papers presented before the Institution of Electrical Engineers on 6th May dealt with the reasons for the choice by the Societé Nationale des Chemins de Fer Français of single-phase locomotives supplied at the grid frequency (50 c/s) for the electrification of the Valenciennes-Thionville line. The author of the first paper, Mr. M. Garreau, claimed that the primary object of reducing capital outlay on stationary equipment had not involved the construction of locomotives that were less satisfactory than those used with d.c. or $16\frac{2}{3}$ c/s and that the selection for the initial experiment of a line on which the starting and hauling of very heavy trains and negotiating considerable gradients were necessary indicated that the system need not be confined to secondary lines.

On the 225 miles of route there would be six substations and 7 miles of h.v. feeder, as against 23 more expensive substations and 211 miles of h.v. feeder with d.c. The 25 kV trolley wires would be 0·233 sq in, compared with 0·744 sq in needed with d.c. at 1·5 kV. In all the cost of stationary equipment would be only 45 per cent of that for d.c. None of the three alternative methods of conversion was available in the early days of electric traction, viz., to d.c. by rotary convertor with Ward-Leonard control, or by mercury-arc rectifiers or to three-phase of variable frequency. The best use of adhesion, which set the limit to tractive effort, was obtained by single-phase locomotives with their smooth voltage regulation. The likelihood of wheel slip was also lessened as the speed/torque characteristic of the motor became steeper. Single-phase $16\frac{2}{3}$ c/s motors were easily damaged if started too slowly, and accelerations of 0·26 to 0·33 ft/sec^2 were normal, whereas with d.c. motors supplied through motor-generators or rectifiers the figure was 0·06 to 0·08 ft/sec^2 which, with a coefficient of adhesion of 2, permitted an increase of 45 per cent in the weight hauled on a gradient of 1 in 100 and of 150 per cent in that hauled on the level. Although few drives now projected included ignitron conversion, the author predicted a great future for this method.

In his paper giving details of the 105 single-cab electric locomotives ordered, Mr. F. Nouvon stated that these were of two basic kinds, viz., 80 with the Co–Co bogie and 20 with the Bo–Bo bogie. The former weighed 120 tons and had a maximum speed of 37 m.p.h.; it was designed to haul goods trains of 1,800 tons on gradients of 1 in 100 or of 2,400 tons on gradients of 1 in 166. The Bo–Bo locomotives weighed 80 tons and their maximum speeds were 65 and 75 m.p.h.; they were intended for mixed passenger and goods traffic. Electrically the Co–Co locomotives fell into two classes, i.e., 65 fitted with s.ph./d.c. rotary convertors and 20 with s.ph./3 ph. generators giving progressive variation in frequency and voltage at the terminals of the traction motors. To have increased the maximum speed to 55 m.p.h. would have necessitated the installation of 5,500 h.p. compared with the proposed 2,490 h.p. The energy consumption of the rotary type with 50 c/s regenerative braking was 25·2 Wh/ton-mile, compared with 34 Wh for a $16\frac{2}{3}$ c/s unit. Locomotives equipped with rectifiers were the most efficient, but when the orders were placed their repercussions on the power supply installations and the possible production of harmonics were unknown. Fifteen of the Bo–Bo locomotives had single-phase motors of 2,750 h.p. (continuous output at 33 m.p.h.). These differed from normal designs in having resistive connections, the absence of compensating windings and the use of capacitors for shunting auxiliary poles. The remaining five locomotives in this category incorporated an ignitron drive with a continuously rated output of 3,260 h.p. at 33·5 m.p.h., at which the tractive effort reached 16 tons—greater than any French Bo–Bo locomotives hitherto constructed. Each locomotive was driven by four traction motors connected in parallel and fed at variable voltage by eight water-cooled ignitrons (8in in diameter) through a transformer.

Atomic Energy Prospects

THE first item on the agenda after the annual luncheon of the Institute of Fuel, which attracted an attendance of about 600 members and guests on 22nd April, was the presentation of the Melchett Medal for 1954 to Dr. H. H. Storch (U.S. Bureau of Mines) by the president, Dr. W. Idris Jones. There was only one toast, "The Guests," to which response was made by Sir Christopher Hinton (Deputy Controller of Atomic Energy (Production), Ministry of Supply). Nuclear fuel, he said, was only an alternative fuel to coal, the easily mined supplies of which would last for only about 200 years and should be reserved as far as possible as chemical raw material which was indispensable to industry.

The production of atomic energy should involve no greater problems than those overcome in building the earliest steam engines and we were now no more advanced than was Watt then. Similarly, however, the problems of providing atomic power would be commonplace knowledge among engineers of coming generations, whose work would be based on present pioneering work. He believed that within ten to fifteen years nuclear power stations would compete in cost with steam stations.

The cost of electricity from an atomic pile of the type now being built in Cumberland would be about 50 per cent higher than that from the B.E.A. stations, but the cost lay mainly in capital charges which would tend to fall while the price of coal would be likely to rise. He regarded the functions of the Atomic Energy Organization as the pioneering of prototype plants and the giving of advice to industrial firms who would be responsible for the design and construction of plants ordered by the British Electricity Authority.

Radio Waves in the Ionosphere

AT a meeting of the Radio Section of the Institution of Electrical Engineers on 5th May two companion papers were presented by Mr. W. R. Piggott (Radio Research Station) and Dr. W. J. G. Beynon (University College, Swansea) under the titles of "The Reflection and Absorption of Radio Waves in the Ionosphere" and "Some Notes on the Absorption of Radio Waves Reflected from the Ionosphere at Oblique Incidence," respectively. In the first paper was given a brief historical review of investigations into absorption carried out in the United Kingdom since 1935, with details of the phenomena to be considered in making accurate measurements. The magnetic-ionic theory of Appleton and Hartree indicated that absorption was due to the dissipation of the energy of electrons vibrating in a radio-frequency field when in collision with other particles. The total loss of energy per unit path was thus proportional to the average energy of vibration of the electrons. This was controlled mainly by the frequency of the incident wave, the electron density and the average number of collisions of each electron per second. If the refractive index of the medium differed significantly from unity, the rate of attenuation would be modified by varying the time taken for the wave to traverse the path.

In his paper Dr. Beynon showed that oblique-incidence studies could conveniently be divided into two parts: the equivalent paths of the echoes received, which included the calculation of the maximum frequency that could be propagated between two stations; and the ionospheric absorption of the waves during transmission from sender to receiver, including the calculation of the optimum communication frequency on which signals would be best attenuated during transmission through the ionosphere. For both short and very long transmission distances a marked difference was found between observed values and values calculated from simple theoretical formulæ. The contribution of multiple ionospheric reflections to the intensity of signals was briefly discussed.

Toronto Plant Failures

IN the early part of April two sets in the Richard L. Hearn plant, Toronto, Canada, failed within a few days of one another. The plant contains four 100 MW turbo-alternators, the first of this size to be built by C. A. Parsons & Co., Ltd., which were placed on the line in the latter part of 1951. The machines are of unit construction, one boiler per turbine, two cylinder, of the impulse reaction type.

Machine No. 1, the first to fail, has been generating at 25 c/s since it was installed, until a few months ago, when it was converted to 60 c/s, the speed being raised from 1,500 r.p.m. to 1,800 r.p.m. The conversion was accomplished by the insertion of a new generator shaft. The second machine had been generating at 60 c/s at 1,800 r.p.m. for more than two years.

According to information received from our Toronto Correspondent the first machine was idling on the barring motor throughout the night of 31st March–1st April, being brought up to speed and placed on the line just before 6 a.m. About 15 minutes later a violent failure occurred, chiefly concentrated, according to observers, at the exciter end of the generator. There were flames and a displacement of the generator stator similar to that which might be expected from a rotor seizure. The generator lifted sufficiently to pull the foundation bolts out of the bedplate, some of them being sheared.

The movement of the generator was apparently responsible for breaking the pipes containing the bearing oil supplies and lubricating oil flowed over the floor and down into the basement, where it caught fire. Other damage included holes pierced in the roof by flying metal and cracks in two walls adjacent to the machine. Nobody was hurt, although all the operating staff were engaged on their normal occupations at the time. It appears that most of the fire damage occurred at the exciter end of the machine.

Investigators were immediately flown out from England to determine the cause, and were at work stripping No. 1 machine when No. 2 machine failed. Although the incidents were almost exactly similar so far as circumstances and effects were concerned, the consequential damage was considerably less in the second instance as the oil fire was this time confined to narrow limits. Many members of the operational and maintenance staff were working around the plant at the time of the second occurrence. Only two of the persons present, however, were sent to hospital, suffering from shock; one of these was a member of the staff of C. A. Parsons.

While the cause of the failures so far remains undisclosed, the plant was entirely shut down pending the result of the investigations.

C. A. Parsons & Co. inform us that the rotor end cap which failed on the No. 1 set has been flown back to this country for examination but so far has not produced evidence helpful in offering a solution of the cause of failure. An undamaged end cap from the No. 2 set is being subjected to tests and the two damaged exciter rotors are being returned for further examination. The results upon the rotors if stored for some time are being studied.

The company stresses that there was no hydrogen explosion. It seems certain that mechanical damage caused a hydrogen leak which was probably ignited by frictional sparking and this in turn led to an oil fire from already broken bearing keeps and oil pipes. It is by no means impossible that frictional heat caused the escaping oil to ignite.

Traction Power Supplies

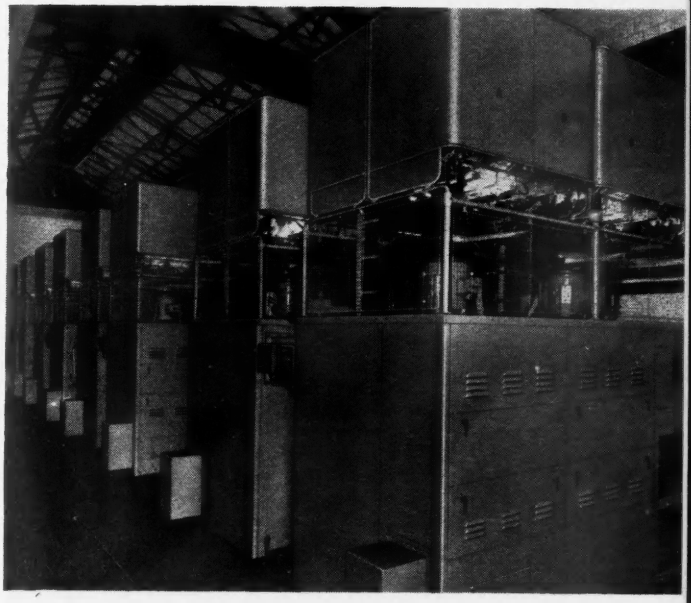
Re-equipment of Bond Street Substation

BOND Street substation, which serves one of the busiest sections of London Transport's Central Line, has been re-equipped with modern plant. The complete change-over was undertaken by the Hackbridge and Hewittic Electric Co., Ltd., in collaboration with London Transport's chief electrical engineer. The operation was planned to be carried out in two main stages, the first consisting of the replacement of the four original rotary convertors by an equal number of Hewittic mercury vapour rectifiers and the second the re-equipment of the switchgear section. The latter involved the installation of a bank of 11 kV oil circuit breakers, two d.c. switchboards (one embodying the latest truck-type high-speed circuit breakers and control panels on the positive busbar and the other withdrawable contactors and panels on the negative side), auxiliary transformers and switchgear for lighting and signalling supplies, etc., and finally the supervisory control gear. The work of re-equipping the substation began early in 1953 and the first main stage was successfully brought to its conclusion in September of that year. Throughout this work there was no interruption to the supply to the railway, despite considerable site difficulties.

The relationship between the required output and the restricted floor space available for the rectifiers constituted a prime factor influencing the design of the equipment; the problem was resolved by the London Transport engineers' decision to combine the rectifier and transformer into one unit, in which the individual parts were so arranged in sections as to permit of their being manœuvred in a small space by only two or three men. The transformers and auxiliaries were then designed to form the base compartments of the equipment over which the cradles enclosing the rectifier bulbs are fitted.

Each 1,000 kW rectifier is made up of two self-contained 500 kW units, and these together occupy about the same floor space as was taken by each rotary convertor. By combining the transformer with the rectifier not only has all interconnecting cabling been dispensed with, but valuable space in the switchgear section originally taken up by rotary transformers has been saved for use in accommodating the new d.c. switchgear and additional items incorporated in the supervisory control scheme.

The supply is taken from London Transport's 11 kV system through 3/6 phase transformers providing the correct voltage for giving a 630 V d.c. output. Oil cooling is entirely dispensed with and the transformers are of the totally enclosed dry-air insulated type. Cooling is by means of a fan-cooled air-to-air heat exchanger through which the air within the transformer case is circulated by a second fan and directed constantly, by means of baffles, through the core and windings and also through the adjoining compartments housing the auxiliary transformer, interphase transformer and fan choke. The phase angles of each pair of transformer primaries are displaced, one



In the re-equipped Bond Street substation combined air-cooled transformer and rectifier units are employed

15 deg forward and one 15 deg backward resulting in 12 phase operation of each 1,000 kW set.

Six three-anode rectifier bulbs are employed on each unit, and these are mounted in two triangular groups each cooled by a single fan. The exciter unit, anode fuses and anode chokes are contained in a separate compartment situated alongside the main transformer. Apart from the fan, the only moving part is the starting relay.

The d.c. positive breakers are of the high-speed truck type and are arranged in a bank of ten with a bus-coupler contactor situated in the centre. These control the four rectifiers, four track feeders and two escalator feeders. Each breaker is electrically interlocked with a corresponding negative contactor, so that the contactor will open immediately after its breaker has tripped. The negative contactors are also of truck type, and the layout is a replica of the positive, arranged face to face, with a passage way between providing common withdrawal space. The high voltage switchgear comprises duplicate busbars and seven 11 kV oil circuit breakers of 350 MVA rupturing capacity.

The whole of the switchgear is designed for operation by remote supervisory control which has not yet been installed. A central control panel, designed and built by London Transport engineers, has been installed in the substation and this gives all indications and alarms. Accordingly, such operations as starting and stopping the rectifier equipments and the closing and tripping of h.v. and d.c. feeder breakers will be, for the present, carried out by means of local control.

The modernization of this supply point has also included complete replacement of the d.c. cables feeding the railway tracks and escalator circuits. These have been installed on a new run via one of the disused lift shafts, which has permitted ample segregation of the cables and ready access for maintenance purposes. There is a vertical drop of 80ft between the upper and lower levels, and all the cables, both h.v. and l.v., are of the non-bleeding type, paper insulated, pre-impregnated with "Diatrine" compound. They were manufactured by W. T. Glover & Co., Ltd., and installed by London Transport staff.

Aluminium-Sheathed Cables

I.E.E. Supply Section Discussion

THE discussion on the paper "Aluminium-Sheathed Cables," by Messrs. P. M. Hollingsworth and P. A. Raine, which was presented before the Supply Section of the Institution of Electrical Engineers on 28th April (see *Electrical Review*, 30th April) was opened by Mr. G. F. Peirson (Midlands Electricity Board).

As users of aluminium cables for substation connections to transformers, his Board, he said, had found the greater rigidity of the sheath produced a neater arrangement than lead, since fewer clamps and supports were required. Installations put in some four years ago appeared perfectly satisfactory. Recent experiments with aluminium-sheathed multi-core control cables (4,000 yd) at a major substation had shown a reduction in cost of supporting racks of at least 25 per cent compared with lead. Individual circuit lengths were, however, short and the bends on each run numerous, increasing installation cost, so that relatively straight aluminium sheathing was likely to give the best financial results. The use to-day of lead-sheathed cables laid in the ground over fifty years ago was one reason why the price of electricity had not gone up very much more. Further development was needed along two lines: the production of aluminium-sheathed cables in greater lengths; and long-life protective coverings.

Differences with Aluminium and Lead

Dr. G. L. J. Bailey (British Non-Ferrous Metals Research Association) ascribed the entry of aluminium into the cable-sheathing field so quickly as largely due to the efforts of the authors of the paper. He asked whether the practice in allowing for cyclic expansion and contraction, and generally in locating fixing points, was very different as between aluminium and lead. He also asked what maximum stresses arose in the vibrated assemblies and how nearly they matched the most severe service conditions. He pointed out that in creep and creep resistance the inherent differences between aluminium and lead resulted in notable differences in cable practice. With lead one might have to wrap up an inherently corrosion-resistant material to confer adequate creep strength for certain applications. With aluminium one sometimes wrapped up an inherently more creep-resistant material to improve its corrosion strength. He and Dr. Gilbert, who was unfortunately unable to be present, would agree entirely on the satisfactory behaviour of aluminium in outdoor exposure, except in severe marine and industrial environments. They endorsed the recommendations for protecting joints where there was a risk of galvanic corrosion.

Mr. J. M. Ward (B.E.A.) said that it ought to be more widely recognized that aluminium needed protection in many areas, such as heavily industrialized and coastal districts. Nothing but an impermeable serving was good enough for underground use of aluminium-sheathed cables and their cost appeared to depend largely on the efficacy of the protection.

Mr. F. W. Rogers (Aluminium Development Association) considered that the next step should be to concentrate on type D, the ultra-light-weight all-aluminium cable with its attendant advantages and economies.

Mr. Forbes Jackson (L.C.C.) held that the price, physical characteristics and availability of aluminium would no doubt lead to its wider use in the future for all kinds of jobs. He was not unduly pessimistic about corrosion. A good case could be made out against even the use of wood or iron, but the principles and methods of protection were known, understood and accepted. No doubt aluminium cables would come to be used as freely as lead cables.

Mr. D. T. Hollingsworth (B.I.C.C.) expressed the view that aluminium-sheathed cable did not offer great advantages over lead technically. Its future use, therefore, would rest on an economic basis. The economic position as regarded welded sheath and the tube sinking process could be described as marginal. The company with which he was associated had concentrated, therefore, on direct extrusion and had now developed an aluminium press extruding direct on to cables in continuous lengths. They regarded this as a development of the greatest importance which might have many repercussions on the cable industry.

Mr. A. J. Good (Johnson & Phillips) gave a brief account of a largely theoretical investigation concerning the tensile force required to draw down an aluminium tube, taking account of work-hardening.

Mr. G. A. Rendle (B.I.C.C.) said his experience was that the aluminium-sheathed cable installation probably cost 40 per cent more than the equivalent installation in lead. The future of this cable was in large diameter sheathing and long lengths.

Mr. H. W. B. Gardiner (G.E.C.) said that the experience of his company in regard to flexing tests was much the same as that of the authors. They too had started with S formation specimens and had ended up with the U formation. The life of aluminium sheathing was similar to that of lead sheathing. This applied to tests on corrugated sheathing made from annealed strip or rolled down sheathing which would therefore have the same amount of cold working as the sheathing mentioned by the authors.

Leakage Current

Mr. J. H. Gosden (B.E.A.) pointed out that the leakage current densities given were reassuringly small provided the current was uniformly distributed over the sheath. If, however, they were situated at relatively small discontinuities in the insulation the resulting corrosion would be serious. He called attention to the recently constituted Joint Committee for the co-ordination of the cathodic protection of buried structures.

Mr. P. Robinson held that lead was the proper choice for general purposes except where price considerations made the substitution of aluminium necessary. For many applications, such as straight runs above the ground along railway tracks and across bridges, however, a change-over was indicated.

Mr. G. S. Buckingham (M.E.B.) emphasized the importance of keeping up-to-date with the techniques of handling aluminium. As it was more abundant than copper or lead, it would undoubtedly have to be made more use of in both the conductors and sheaths of cables.

Mr. H. M. Powell (Costain-John Brown) submitted that cathodic protection raised many problems that were far from solution. His company was collaborating in experiments with the authors from which they hoped to obtain valuable data on protection.

Electrical Research

Association's Annual Report and Luncheon

IT is pleasing to read in the foreword by Mr. C. T. Melling, chairman of the Council, to the thirty-third annual report of the British Electrical and Allied Industries Research Association for 1953 that the co-operation between the Association, the electricity supply industry and the manufacturing industry continued in full measure throughout the year. In earlier pages the name of the 1953–54 president, Sir John Hacking, M.I.E.E., is followed by a list of twenty or so names of other distinguished engineers and electrical men, as past presidents, while on another page Mr. Melling's name heads the list of thirty or so names of members of the Council.

The request last year for a 20 per cent increase in contributions met with a very favourable response, enabling the Association to meet its increased commitments with a margin in hand. These increased commitments arose partly from the general increase in costs, particularly staff costs, but some expansion also became possible. Although the total income is growing, some further efforts to increase grant-earning income is essential to take full advantage of the terms of the D.S.I.R. grant; this is the more necessary since there is every reason to believe that the cost of research will continue to rise this year and also since non-grant-earning income is usually associated with particular groups of researches.

New Leatherhead Laboratories

The E.R.A.'s capital position mainly depends upon the Leatherhead project, which is dealt with in a separate section of the Report. During the first quarter of 1953 the Association applied to the D.S.I.R. for a capital grant of £100,000 towards the new buildings at Leatherhead, and a deputation waited on the Industrial Grants Committee. On 17th September, 1953, the D.S.I.R. notified the Association that the Government was prepared to make a grant of up to £100,000 subject to various conditions, the most important of which were that the Association should meet £100,000 of the cost from its reserves before any Government grant was spent, and that the total capital contributions paid by or guaranteed from members should attain £200,000. The capital contributions do not yet quite reach £200,000, but the Council confidently believe that the further approaches, which are being made to members who have not yet guaranteed a contribution, will produce the sum required.

The British Electrical Development Association's Testing Station was officially opened during the year, and the proximity of this station should be of great help to both organizations. At the end of the year the B.E.A. asked whether it could acquire a parcel of land on the E.R.A. site for use in connection with adjoining land purchased by the B.E.A. for certain investigations, mainly of an outdoor character, and this request is being considered by the E.R.A. Council.

The main effort in the researches which concern generation remains in the domain of high temperature alloy steels. This is to be expected since generating plant is being ordered for temperatures and pressures for which long-term creep and relaxation tests on the steels are not yet complete. These must extend from 10,000 to 30,000 hours and are made by the National Physical Laboratory in co-operative investigations supported not only from the E.R.A. general funds, but also by the British Iron and Steel Research Association, and turbine, boiler and tube makers and others. It is hoped in 1954 to increase this work substantially beyond the £10,000 allotted in 1953, and the Association has already received promises of additional financial help, including a promise of assistance from the Parsons and Marine Engineering Turbine Research and Development Association.

The E.R.A. has continued its co-operation with the North of Scotland Hydro-Electric Board, the British Electricity Authority, and the manufacturers on the 100 kW wind-driven generator already installed and working in the Orkneys and the 100 kW generator which will probably be erected in Wales.

The Sub-Committee of which Sir Eric Rideal is now chairman provides technical discussion and co-ordination of the E.R.A. programmes and the work sponsored by the B.E.A. and Ministry of Fuel and Power on the direct electrochemical generation of electrical power, while the investigators for the E.R.A. at Cambridge on the gas cell made significant progress last year in overcoming the corrosion of the oxygen electrode which so far has limited the life of the cell. The appropriate authorities are considering the possibility of a trial d.c. transmission at high voltage over a fourth (spare) cable which might be included in the proposed power link between the systems of the B.E.A. and Electricité de France.

There is increasing interest in the use of series capacitance to improve the regulation and stability of long overhead lines. The main difficulty is to avoid damage to the capacitance when accidental short-circuits occur, and in studying this problem the Association has made full-scale tests on one proposed device. Work on the E.R.A. network analyser, described elsewhere in this issue, was advanced considerably, and it has been in frequent service, for example on the rates of rise of restriking voltages on the 132 kV and 275 kV systems.

The Association has further pursued its improvements to the a.c. air-break arc-chute type circuit breaker by means of high power proving station tests. High power tests were also made on the measurement of post-zero current in an a.c. arc broken by an experimental gas-blast circuit breaker. The lectures last year on E.R.A. circuit-breaker researches have been published as a book. The facilities for contactor researches have been expanded for both a.c. and d.c. breaking capacity and wear tests.

Dual-Purpose Heat Pumps

The industrial interest in the heat pump is now such that the E.R.A., although it continues its full-scale trial at the Shinfield Field Station and its studies of more efficient components, can now concentrate on favourable applications where a double purpose can be served. One example is where a heat pump cools the larder and heats water for the sink.

Floor heating by buried electric resistance wires, using the thermal storage unit based on latent heat, mentioned last year, has been further developed.

The extensive new installations (including a new road) for studying pressure piling in large flameproof motors while running are now complete and test motors are available so that results are now being obtained.

In collaboration with the British Welding Research Association, study of arc length control in self-adjusting welding arcs has led to the development of improved d.c. and a.c. power sources, with low open circuit voltages and flat outputs, which permit a high degree of self-adjustment and simplicity in operation. Further development of the surge injector unit includes the a.c. self-adjusting arc as well as the argon arc.

Work on low voltage platinum contacts has shown the existence of several types of discharge, including transient arcs, at very low circuit inductances. At Perivale it has been possible for the first time to follow the dielectric properties of solid solutions during nucleation and the corresponding changes in crystal texture. A long chain secondary alcohol has been synthesized to explore reported high permittivities.

The N.P.L. has extended its comprehensive study of dielectric properties to silicone liquids, greases and rubbers, and also to new ketone resins prepared at the National Chemical Laboratory. A paper on past work was awarded the Mather Premium by the I.E.E. The general theory of electrons in solids, started at Liverpool, has become a major theoretical research; canonical methods and exact principles are now being established, including the theory of "polarons." Work at Oxford on the hollow cathode is complete and attention turned to cathode mechanisms in arc discharges. A considerable advance in the theory of the concentration of an a.c. arc was made at Perivale during the year. The general theory of the ionization and radiation from discharges has been pursued at Liverpool. A new theory of breakdown at micro-wave frequencies has been developed at Durham and will be tested by experiments with high-frequency pulses of from 1 microsecond to 1 millisecond duration. The British Iron and Steel Research Association is undertaking some fundamental research on transformer steel under a joint B.I.S.R.A.-E.R.A. Committee. On the measurement side University College workers have measured the losses in several grades of silicon iron sheet up to induction of 23,000 gauss.

On the membership side the technical liaison officer has conducted negotiations leading to twenty new applications. The success of the technical liaison department will require increase in its staff as soon as possible.

The Library and Information Bureau has continued its services and the esteem in which they are held by members increases so that arrangements have had to be made with some urgency to strengthen the translation facilities. The loans of journals and books to members, arising from the information services, has grown to 6,000 a year.

Specific researches are dealt with in the Report under eighteen headings, including: insulation and dielectrics; switch and control gear; steam power plant and condensers; surge phenomena; integrating meters and rural electrification.

Part of the Report consists of a list of about 70 translations made by the Association during the year. Then follow a list of bibliographies prepared and made available to members during the year and a long list of reports, based on E.R.A. Reports which were published in the technical Press. A list of Reports issued during the year, arranged in letter order, just accommodates the alphabet.

ANNUAL LUNCHEON

At the annual luncheon on 30th April the toast "The E.R.A." was proposed by the guest of honour, Viscount Waverley, who said that although he would be the last to suggest any drastic change by way of reduction in industrial research expenditure, in his view it was worth while considering whether in that expenditure to-day a proper balance was being maintained. In other words, was fundamental research not in some cases being carried rather wastefully beyond the existing possibilities of effective application? It was often said that not enough money was being spent by industry in this country on development; but surely it was not just a question of money. The money might be there, but the useful application of the money depended on the availability of materials and of men. Were there the technologists to match and to balance the scientists who were concerned with fundamental research?

Dealing with research by individual firms and others, Lord Waverley said he had frequently been struck by the smallness of the contribution made by the largest firms in industry to the research association for their particular industry in comparison with what they spent directly on research. There might be a feeling that large firms spending great sums of money on their own researches had no direct interest in the research carried on by an association, but Lord Waverley suggested that it was rather a short-sighted view because, particularly in regard to exports, the prestige of a particular industry should be the concern of all operating within it, large or small.

The president, Sir Lawrence Bragg, in response, said that the Department of Scientific and Industrial Research which, as Lord Waverley pointed out, was the first direct step taken by the Government to assume responsibility for research in relation to industry, meant a great deal to pure research in this country. Over 90 per cent of the young men who took their degrees and went on to get a three-year training in research were supported by that body. It was almost impossible to think what would happen to pure research in this country if that support were withdrawn. "It has helped us all in a way which it is impossible to exaggerate," said the president. "Our research would have been non-existent or only carried on in a trivial way had it not been there to back us up."

In thanking members of the Association for having elected him president, Sir Lawrence confessed that he could not speak with any inside knowledge of the projects of the Association as past-presidents had been able to do. However, he was not altogether without links with the Association. In fact it would probably be impossible for anyone in any physics or electrical engineering laboratory in the country not to have links with the E.R.A. He was rather encouraged to feel that his presence as president was not wholly unconnected with his new post as Resident Professor at the Royal Institution.

Dealing with the application of research to industrial projects, Sir Lawrence said there were very great difficulties which should not be minimized. Those difficulties were present even in the case of the electrical industry which, perhaps more than any other industry, was closely related to research and dependent on pure research. One of the greatest difficulties was of a psychological kind, because there were and always would be two extreme types of human being. The antitheses were the man of action and the dreamer, the organizer and the artist and, with equal force, the industrialist and the scientist. The scientist and research worker could make a hundred failures if he pulled off one success. He must not try to reach a conclusion until he had weighed all the evidence. He hated making decisions. He tried to work out his problems in isolation, to remove all the factors except one, so that he could see what that one factor did. But the manufacturer had to make decisions and he could not isolate factors. He often had to make decisions on what the scientist would call insufficient evidence. It was real

(*Continued at foot of next page*)

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Atmospheric Pollution

IN your issue of 30th April you give a brief account of a paper by Mr. F. S. Mallette dealing with air pollution presented before the Institution of Mechanical Engineers on 23rd April.

It is suggested that no satisfactory explanation has been offered of the disastrous effects of (among others) the fog in London in 1952. In my opinion, and I do not doubt that my opinion is shared by many others, these disastrous effects are due to the noxious fumes of motor vehicles in general, and particularly to the heavy diesel-engined type. These fumes, especially when accompanied by clouds of soot or partly-burnt oil, inevitably contain a substantial proportion of carbon monoxide. This poisonous and lethal gas forms a stable compound with the haemoglobin of the blood and interferes with its action to an extent which can easily prove fatal. These facts are well known but for some reason, which is not apparent, they are studiously ignored.

The news that trolley-buses in the London area are to be replaced by diesel buses suggests that a recurrence of the atmospheric conditions of 1952 will entail an even greater death-roll.

Belmont, Surrey. C. C. DOWNIE.

Electrical Films

I HAVE read with interest the article on "Electrical Films" in your issue of 9th April. The lists of films available will be extremely useful to many present and prospective users.

There are, however, one or two points on which I would like to comment. The first is the reference to screen sizes—8ft by 7ft and 7ft by 6ft. Surely the normal small cine-screen ratio is 4 : 3 and consequently standard screen sizes are 8ft by 6ft and 6ft by 4ft 6in.

Also, the writer says that "If the [sound] track is poorly recorded there is always the possibility of obtaining a replacement copy before the actual performance." I would say that "always" is hardly the right word, as if the sound was poorly *recorded* the only thing to do is to juggle with the tone control on the amplifier in an effort to get acceptable results. I think that what your contributor really meant was that if the copy of the film had been badly *printed* there was a possibility of getting another copy which might have a reasonable sound track.

I am afraid I was rather amused at the suggestion never to employ an operator who has not been trained as an electrician and has not obtained a tradesman's certificate. Certainly it is good sense to satisfy yourself that the operator is capable, but the mere possession of an electrician's ticket will not ensure that.

Cine projection—to be done properly—involves knowledge of electricity, heat, light, sound, audio-amplifiers, mechanics, etc., and an intelligent amateur with such knowledge is often much better than a professional who has been trained in one subject only.

Broxbourne, Herts. T. L. FRANKLIN.

Hydraulic Constant-Speed Drives

IN an article entitled "Aircraft Electrical Machines" by Messrs. L. J. Clark and A. Hossle in your issue of 16th April there appears this statement:—

> "One form of hydraulic constant-speed drive is actually employed in some American military aircraft, but it has not been developed for general production."

This passage expresses a fairly general belief that hydraulic drives have proved unsatisfactory for generating constant frequency alternating current for aircraft. But this belief is false, and I feel that the passage requires some correction.

One hydro-mechanical drive manufactured by the Sundstrand Machine Tool Corporation is in large-scale production in the United States and is employed in a number of production American aircraft with very satisfactory results. It has a life of 800 hours between overhauls and maintains frequency to within plus or minus ½ per cent. Load sharing for parallel alternators is maintained within very close limits.

Your readers may also be interested to know that the Aircraft Equipment Division of the English Electric Co., Ltd., is engaged on the manufacture of the "Sundstrand" drive under licence from the Aviation Division of the Sundstrand Corporation and the system will soon be available to the British aircraft industry.

Bradford. P. J. DAGLISH, B.Sc., A.M.I.E.E.,
Manager,
Aircraft Equipment Division,
English Electric Co., Ltd.

Electrical Research—*Continued*

hard for the one type to understand the other, so that the kind of thing which the scientist did could be used by the industrialist. It was natural for each to be rather impatient of the things which the other could not do. "It does seem to me that this is the gap which the Research Association has to try and bridge," concluded the president, "but I am sure you will all agree with me that the Electrical Research Association and Dr. Whitehead succeed admirably in this aim."

Mr. C. T. Melling, in proposing the toast of "The President," said the E.R.A. was very privileged to have Sir Lawrence Bragg as president, coming as he did at a time when the Association was looking forward to big developments in its work, looking forward to taking over new laboratories and to further success in the illimitable field of electrical matters. Sir Lawrence Bragg gave to the Association great inspiration and brought to it a freshness of mind and a broad outlook.

I.E.E. Annual Report

Copies of the annual report of the Council of the Institution of Electrical Engineers for session 1953–54 and of the accounts for the year ended 31st December, 1953, which are to be presented at the annual general meeting of the Institution on Thursday, 20th May, at 5.30 p.m., can now be obtained by members of the Institution on application to the secretary.

INDUSTRIAL NEWS

Dearer Coal and Iron

THE JOINT IRON COUNCIL, which represents the producers of foundry pig iron and the ironfounding industry, has issued a statement regarding the price increases in coal announced by the National Coal Board, which include increases in the price of coal used for making coke. The ironfounding industry, it is said, will suffer both through its use of pig iron (embodying higher charges for blast furnace coke) and of coke used for its own melting purposes.

Serious and almost immediate effects will be inevitable as a result of the sharp upward movement of coke prices. Categories concerned will include nearly the whole range of engineering products, which embody many iron castings. Higher costs for iron castings could exert a depressing influence upon the competitive efforts of the engineering industry in the export markets.

The Joint Iron Council does not believe that these price increases are justified, either as regards coal in general or coking coal in particular, and it feels strongly that the whole question of the National Coal Board's policy in further increasing the price of coal, with dangerous consequences to industry and perhaps to employment, should be thoroughly and critically examined on the floor of the House of Commons.

Materials Handling Convention

The first National Convention organized by the Institute of Materials Handling took place under the chairmanship of Mr. A. Fraser Much, A.C.A. (honorary treasurer of the Institute), at the Central Ordnance Depot, Didcot, Berkshire, on 29th April. The theme of the Convention was "Industrial Trucks and Methods," and a comprehensive programme included demonstrations of improved stores handling and of specialized ancillary equipment for use with industrial trucks. These demonstrations were arranged and directed by I.T.D., Ltd., and Lansing-Bagnall, Ltd., commentaries being prepared and spoken by executives of both companies. Two papers were read. The first, on "Operator Selection and Training," was presented by Mr. A. C. Cooper, M.S.M.A., and the second, on the subject of "Preventive Maintenance," was given by Mr. A. R. E. Arnot, B.Sc. (Eng., Hons.), A.M.I.E.E. Following the final demonstration, a panel of industrial truck manufacturers was available to answer a number of questions which were put during an "Open Forum" session by a keen audience.

The Institute hopes to organize further Conventions and demonstrations, and details can be obtained from the Secretary, 20/21, Took's Court, Cursitor Street, London, E.C.4.

Engineering Industry Wages

Dissatisfaction with the recent increase of wages granted to engineering workers has been expressed in resolutions put before the annual conference of the Amalgamated Engineering Union at Blackpool this week. The Union's executive council has been urged to press for a further rise.

Discussions with the Engineering Employers' Federation on behalf of salaried workers in the industry last week failed to secure a settlement. Among the people affected are draughtsmen, tracers, planning engineers, clerical staff and scientific workers. A proposed scale of increases according to age proved unacceptable to the employers who offered a flat-rate increase.

Chinese Contracts

Negotiations between a group of about 50 British business men and the China National Import-Export Corporation in Berlin last week are reported to have resulted in contracts valued at over £4 million so far. About a quarter of the contracts (in value) are dependent upon the granting of export licences by the Board of Trade but the rest are said to be firm contracts.

Among the goods involved engineering products, electrical equipment and cables have been mentioned but no details are yet available.

Anglo-Russian Trade

Speaking at the 38th annual meeting of the Russo-British Chamber of Commerce on 29th April, Sir Greville Maginness, the president (who is chairman of the Churchill Machine Tool Co., Ltd.) said that this was the first time for four years that he had had anything of interest to report about Anglo-Soviet trade. In recent months there had been a considerable change in the position and there were welcome signs of increased trading between the two countries.

He understood that since the beginning of the year firm orders had been placed by the Soviet importing organizations to the value of between £30 and £40 million; among them he mentioned substantial orders for diesel generating sets, power cables, switchgear and other electrical equipment.

Referring to visits already made to Russia by British business men, the president stressed the importance of personal contacts but mentioned that it was necessary to secure the sponsorship of the Soviet foreign trade organizations concerned. During a recent visit to Moscow his invitation to Mr. N. V. Nesterov, president of the All-Union Chamber of Commerce, to visit this country with heads of the appropriate trade organizations was well received and it was provisionally agreed that such a visit might be made this summer—probably in September.

New Remploy Showrooms

Remploy, Ltd., have opened new showrooms at Oxgate Lane, Cricklewood, London, N.W.2, where it is possible to see the full range of the company's products, including the electrical appliances referred to in our article on page 752 of our 23rd April issue.

Housewives and Air Pollution

The Electrical Association for Women has sent us a copy of its "Report of an Inquiry into the Housewife's Point of View on Smoke Pollution" which was submitted as evidence to the Committee on Air Pollution under the chairmanship of Sir Hugh Beaver.

Trade with Brazil

The Export Credits Guarantee Department announces that it is resuming a limited cover on exports to Brazil. It suspended the issue of all fresh cover for Brazil in May, 1952, at a time when its gross liabilities in that market totalled some £32 million. Cover on resumption will be limited to 80 per cent of the credit granted (as against the normal 90 per cent for most risks); the waiting period before loss is ascertained will be 12 months (as against the normal 6 months); there will be no cover for goods not of United Kingdom origin; exchange sale notes must be produced covering all payments due; and the Department will require prior proof of compliance with import licensing and exchange formalities before it comes on risk for any transactions.

The existing scheme for cover on shipments of spare parts (the only form of cover currently available) will continue to operate.

Industrial Fuel Efficiency

Transfer of responsibility to the National Industrial Fuel Efficiency Service from the Ministry of Fuel and Power took place on 1st May. Sir Leslie Hollinghurst, chairman of the board of the new Service, stated last week that arrangements had already been made for the secondment to the N.I.F.E.S. of the majority of the engineering staff of the Ministry's Fuel Efficiency Branch, to form the nucleus

of the new organization. He stressed the fact that the Service would collaborate with existing organizations that were aiming at improving the efficiency with which fuel was used in industry.

The Ministry was handing over its mobile testing units for measuring the consumption of steam throughout a factory and tracing losses to their sources. Those heat and power surveys would be made available to industry at the same charge as before. General advice on fuel efficiency had been provided by the Ministry free, and here again no immediate charge would be made. However, Sir Leslie pointed out that a considerable development in the scale of operations would be possible only if the N.I.F.E.S. was able to earn revenue to supplement the financial support it was receiving from the fuel industries.

The head offices of the Service are at 71, Grosvenor Street, W.1 (Hyde Park 9706). The Scottish office is at 145, St. Vincent Street, Glasgow, C.2 (Glasgow City 7636). In the next few months N.I.F.E.S. expects to open district offices in Leeds, Manchester, Birmingham, Cardiff and Bristol, with sub-offices elsewhere. Meanwhile, the work will continue from the Ministry of Fuel and Power's Regional offices in those cities, and also in Newcastle, Nottingham, Cambridge, Reading and Tunbridge Wells.

Revised Purchase Tax Notice

Notice No. 78 (Goods Chargeable with Purchase Tax), issued by the Commissioners of Customs and Excise, has been revised and copies of the new edition have been sent to traders registered for purchase tax purposes and to trade associations.

The revised notice, which supersedes Notices Nos. 78 (January, 1953) and 78G (January, 1954), takes account of the alterations in rates of charge on electric space heaters and water heaters in January last.

Ewbank and Partners (Canada)

Ewbank and Partners, Ltd., are setting up in Canada an associated company, Ewbank and Partners (Canada), Ltd., with headquarters in Toronto. The new company will be under the general direction of Mr. J. T. Moore, a director of the parent company, and until recently chief engineer of the English Electric Co., Ltd. The Canadian company will operate in close association with Crippen Wright Engineering, Ltd., Vancouver, engineering consultants in the hydro and civil engineering fields.

Works Visit

On 22nd April Australian and New Zealand Government officials visited the Tottenham, London, factories of the Benjamin Electric, Ltd., to see the organization and industrial and commercial lighting fittings being manufactured for the Australian and New Zealand markets. Following the visit,

Australian and New Zealand visitors at the works of the Benjamin Electric, Ltd. Left to right: Mr. F. Johnson, British Australasian, Ltd.; Mr. Trevor Campbell, Director, Department of Information, New Zealand; Mr. V. G. E. Gardner, publicity manager, Benjamin Electric; Mr. J. B. Pendergast, Senior Trade Commissioner for New Zealand; Mr. M. Millar, Benjamin Electric; Mr. H. G. Campbell, joint managing director, Benjamin Electric; the Hon. J. M. Tully, Agent-General for New South Wales; Mr. E. McCarthy, C.B.E., Deputy High Commissioner for Australia; Mr. S. G. Carter, Official Secretary to the Agent-General for Victoria

there was a luncheon at the Whitehall Court, S.W.1, where the party was joined by Mr. Guy Campbell, chairman and joint managing director of the Benjamin Electric, Ltd., and Mr. A. C. Williams, director, Department of Information, Australia. The accompanying picture was taken outside the company's offices during the visit.

Westminster Factory

Monday of last week saw the official opening by the Mayor of Westminster (Ald. C. P. Russell) of a new two-storey factory belonging to W. G. Walker & Co. (Engineers), Ltd. Situated in Hide Place, off Vincent Square, London, S.W.1, the new building occupies a floor space of approximately 9,000 sq ft and accommodates over fifty workpeople.

The manufacturing activities are devoted to the production of "Mainstay" metal trunking and busbars and fan brake dynamometers. General light machining and sheet metal work is also carried out.

The electrical installation employs M.E.M. switchboards and fuse gear and the company's own "Mainstay" trunking; this work was carried out by A. V. Gifkins & Co., Ltd. The administrative offices of W. G. Walker & Co. (Engineers), Ltd., remain at Emery Hill Street, London, S.W.1.

Indian Electrical Manufacture

The presidential address at the Indian Electrical Manufacturers' Association's sixth annual meeting in Delhi dwelt on some of the difficulties the Association is trying to overcome in finding ways of fully utilizing the industry's capacity. Although the production has been stepped up all round, the capacity is not being used to its full extent. This has led the Government to appoint a committee to inquire into the problem and to suggest remedies. People in India, it is stated, still fight shy of indigenous electrical goods and the assistance of the Indian Standards Institution is being sought in producing goods to its specifications and in setting up general standards of good production. The Association has also suggested the establishment of a national laboratory as in the United Kingdom to offer facilities to the industry for testing specialized equipment. There is already close collaboration between the various national laboratories and the industry, but these laboratories with their emphasis on theoretical problems have yet to adapt themselves to the particular problems of the electrical industry in India.

Work Study Conference

A two-day conference devoted to work study is being held by the British Institute of Management at Harrogate from 27th to 29th May. The programme is designed to give top management a wider understanding of the subject, and to relate the general principles of work study to the circumstances obtaining in different trades and processes. The conference fee will be £5 5s, and the Institute's address is 8, Hill Street, London, W.1.

Birmingham Engineering Centre

The new Birmingham Exchange and Engineering Centre, which will be Britain's only permanent engineering exhibition, is to be opened by Lord Bennett on 17th June. More than 200 firms are exhibiting and all the exhibition space has now been taken.

Relay Television for Eastbourne

In the course of the installation of a television relay network at Eastbourne, Sussex, Link Relay Vision, Ltd., required a direct cable link between two of its principal stations. Every precaution had to be taken to ensure the least possible distortion of signal and part of the link between the two stations consists of a special underground precision multicore cable designed by British Insulated Callender's

Cables, Ltd., and manufactured in one length of 1,500 yd at the Helsby works. This special cable contains four polythene insulated screened quad units and fifteen single-core polythene insulated conductors and makes provision for future development, including the introduction of multiple television programmes. It runs across a part of the Eastbourne Corporation territory where overhead wiring would have been unsuitable. Besides the relay cables, B.I.C.C. also supplied 850 yd of three-core 660 V mains cable required for power supply. In view of the rapid variation of levels encountered, mass-impregnated non-draining type was used.

J. Stone & Co.'s Acquisition

J. Stone & Co., Ltd., of Deptford and Charlton, have bought the engineering interests of Chance Brothers, Ltd., Smethwick. These interests include the manufacture of "Sumo" electrical submersible pumps, marine lighting and lighthouse equipment and fog signalling apparatus, and "Austinlite" automatically controlled electric generating plant, switches and instruments. A new company will be formed, to be called Stone-Chance, Ltd., with Mr. B. Preston, deputy chairman of J. Stone (Holdings), Ltd., as chairman, and Mr. J. Raymond, who has up to now been managing director of Chance Brothers, as managing director. The two principal subsidiary companies, Sumo Pumps, Ltd., and Austinlite, Ltd., will continue to handle pumps and electrical equipment.

The reason for the sale is that the business carried on by the Engineering Division of Chance Brothers has over the years become remote from glass-making, and the sale follows logically the separation last year of the management of the Division from those dealing with glass manufacture. Chance Brothers, Ltd., will continue to manufacture the glass products, with Dr. W. M. Hampton, formerly technical director, as managing director, and Mr. C. J. S. Newman as deputy.

Twickenham Station

In our issue of 16th April, we published a picture of the platform lighting of the new Twickenham Station of the Southern Region, British Railways. Although "Osram" new warm white fluorescent tubes have been installed throughout the station, the fittings under the platform canopies are of "Metrovick" design and manufacture.

The platform lighting fitting designed and manufactured by the Metropolitan-Vickers Electrical Co., Ltd., installed under the platform canopies at Twickenham Station

The lanterns on unroofed sections of the platforms were made by the General Electric Co., Ltd. One of the fittings designed by the Metropolitan-Vickers Electrical Co., Ltd., is shown in the accompanying picture.

A.E.M.T. Convention

The Association of Electrical Machinery Trades held its Annual Convention this year at Swanage, Dorset, from 25th to 27th April, under the chairmanship of Mr. G. W. Smith of Carlisle. The Convention was supported by over sixty members and their ladies and was the most successful yet organized by the Association.

The Convention opened on the Monday morning with a meeting of the Council of the Association at which it was decided that the annual general meeting of the Association would be held this year on 21st June, in London. On the Monday afternoon, following an official luncheon, the members heard a paper on "The Electrical Uses of Carbon" presented by Messrs. A. E. Feaver and G. Batho of the Morgan Crucible Co., Ltd. In the evening a dinner and dance was held. The second paper, "Variable Speed Motors for Use on A.C. Supply," was presented by Mr. A. Clive Lane, of the B.T.H. Co., Ltd., on Tuesday morning.

Trade Announcements

Brook Motors, Ltd., announces that its Glasgow sales office has been moved to Carlton House, Blythswood Square, Glasgow, C.2 (telephone: Central 1045).

Enfield Cables, Ltd., have opened a new branch at 42, Hamilton Place, Edinburgh (telephone: Caledonian 3041). The branch manager is Mr. J. T. F. Lippett.

A Reyrolle & Co., Ltd., have moved their Leeds office from Park Row to 20–22, St. Paul's Street, Leeds, 1. As previously, this joint North Midlands and Leeds area office is under the control of their manager, Mr. A. J. Coveney. The telephone number remains unchanged (Leeds 21521).

London Trolley-bus Replacement

LAST week London Transport announced that its electric trolley-bus fleet (with the exception of a small number in the south-west suburbs) was to be replaced by diesel oil buses of a new lightweight type, beginning in about three years' time, with the approval of the British Transport Commission, and after consultation with the Minister of Transport.

There are now 64 trolley-bus services, with 253 miles of route, carrying 750 million passengers a year, or a fifth of London's road passengers.

All London trolley-buses, except those in one area, will have completed their useful lives (21 years) in a few years' time; thereafter, maintenance will be heavy and uneconomic.

The conversion will involve some 1,600 vehicles—twice as many as in the south London tram conversion. It is contended that the replacement of trolley-buses by oil buses will give a more flexible, more evenly running, more reliable and better integrated road transport system. It is estimated that the running costs will be virtually the same whether oil buses or new trolley-buses are used.

The new bus which is to replace the 70-seater trolley-bus is designed to seat 64 passengers. It will be 8ft in width—6in wider than the majority of present London buses, and 27ft long, which is one foot longer than the present buses. It will have a light-weight aluminium body. Though it will take eight more passengers than the present London "RT" bus, it will weigh no more with a full load of passengers which will mean fuel saving and other economies. The new bus will also have a greatly improved suspension and transmission system, designed to give smooth operation.

It is stated that there will be no waste of power station capacity because the full capacity of London Transport's own power stations will become available for its other needs, mainly on the Underground.

The seven trolley-bus routes in the Kingston, Surbiton, Hampton, Twickenham and Hounslow area of south-west London are to be retained for the time being. These routes were equipped with new trolley-buses after the war and these will continue in service until they have completed their full life. This will entail no problem, since the routes are self-contained and are based on the Fulwell and Isleworth Depots.

"Retrograde Step"

Commenting on London Transport's proposal, an official of the British Electrical and Allied Manufacturers' Association said: "This decision may well have an adverse effect on Londoners' fares. Trolley-buses use electricity, a home produced fuel. Oil is imported and its supply is subject to factors beyond the control of this country. Trolley-buses solve one of the major problems of London Transport, the moving of the greatest possible number of people in the shortest possible time. In fact, in a year they carry 747 million passengers, 75 million more than are carried by the Underground Railways. The proposed replacement is a retrograde step which would only add to the travelling problems of both inner and outer London, and would be bound to cause dislocation and inconvenience to the public."

The Ionosphere

Kelvin Lecture at the Institution of Electrical Engineers

THE forty-fifth Kelvin Lecture was delivered at the Institution of Electrical Engineers on 29th April, when Mr. J. A. Ratcliffe took as his theme "The Physics of the Ionosphere." He recalled that thirty years ago next December it was first demonstrated that radio waves could be reflected from the ionized portions of the upper atmosphere, and that discovery started a major study of those reflections from two points of view. The first was what might be called the engineering point of view—what could be found out about the propagation of waves by studying their reflections from the upper atmosphere, and how investigations could lead to an improvement in the use of radio waves. The second point of view was what might be called the physical—the upper atmosphere itself and the electrification of that upper atmosphere. Investigation of the physics of the ionosphere was now in its very early stages.

Electron Density Calculation

There were in the ionosphere two layers, the upper reflecting high frequency waves and the lower reflecting low frequency waves. If electron density were plotted against height, there was a big layer with a maximum electron density at the top and below that a little layer with a lower maximum electron density. If there were a frequency which was reflected from one or other of those layers, that penetration frequency could be related to the maximum electron density in each of the layers in turn. By observing the critical penetration frequencies at which those two layers ceased to reflect, the maximum electron densities in the two layers could be deduced. The top or F layer as it was originally called was at a maximum height of 250 km and the lower or E layer at 100 km. The critical frequency was easy to determine and during the war variations of maximum electron density became important because the engineer desired to know what wavelengths to use to cover certain distances. A series of ionospheric observatories grew up and it became apparent that the E layer did, roughly, that which was expected on the theory and the F layer did everything that was not expected on the theory.

Shape of Layer

Mr. Ratcliffe then showed a number of slides illustrating how the ionosphere changed with the seasons and how it was affected by sun spots. It was suggested, he said, that maximum electron density might vary because the shape of the layer was changing and that led to the question of how the shape of the layer could be studied as distinct from maximum electron density. The shape of the layer had recently been derived from the curves in which effective height was plotted against frequency.

If the electron density were known as a function of height, then the velocity of a group of radio waves through the place where the electron density was known was determined. Therefore it would be possible to find the velocity up to reflection point, integrate it, and then find the total time. If one knew the electrical distribution the time of travel for different frequencies could readily be found. The real problem, however, was that, whereas the time of travel for different frequencies was known, the electron distribution was not. It was an old problem which was solved in terms of Abel's integral equation which could be applied to the ionospheric problem in the same way as for a mechanical problem.

Mr. Ratcliffe then showed a short film illustrating the changes in conditions of the ionosphere throughout the day and night and the violent movements which took place. The film was made by photographing every so often the trace in which there was the equivalent height against frequency and re-projecting the changes. By studying the shape of the layers it became apparent that the outermost parts of the atmosphere were in a state of very violent movement. There were great changes in the thickness of the layer through the day and the seasons and there were also short term changes. That was one of the main lines along which investigations were proceeding.

A second line of thought which resulted in a similar conclusion resulted from the study of small scale irregularities in the ionosphere. The ionosphere produced a diffraction pattern on the ground as a result of its being irradiated from the ground. From a study of the diffracted wave which came to the ground a decision could be made with regard to the upper atmosphere which produced it. Irregularities in the ionosphere were then shown by a series of slides.

"Whistling Atmospheric"

A third method referred to the outermost part of the ionosphere, and introduced a phenomenon known as the "whistling atmospheric." This was nothing but an audio amplifier which received only audio frequencies and was connected to a big aerial with no transmitter. The theory suggested was that each audio frequency wave started off with a strong lightning flash and would go into the ionosphere which, being subjected to the earth's magnetic field, was non-isotropic. Audio frequency waves in the ionosphere would thus be constrained to move along the earth's magnetic line of force. While travelling through the ionosphere they were dispersed in such a way that high frequencies arrived first; hence the whistle. Mr. Ratcliffe concluded his lecture by playing a record made of the "atmospheric whistle."

Fluorescent Lighting Fittings

B.S. 2467 : 1954 has been prepared to cover those factors which affect the safety and protection of the user of non-portable lighting fittings for use with hot cathode tubular fluorescent lamps where the nominal maintained voltage at the incoming terminals of the fittings does not exceed 250 V. This new standard, which is entitled "Minimum safety requirements for lighting fittings for use with hot cathode tubular fluorescent lamps" (British Standards Institution, 2, Park Street, London, W.1, price 2s), includes clauses devoted to design and construction, materials, and mechanical and electrical requirements, together with appropriate tests. It does not, of course, in any way over-ride any statutory regulations which apply when these fittings are used in factories, stores, etc., where more stringent requirements may be necessary; such regulations, where they exist, must always take precedence.

Transductor Development

THE discussion on two papers on transductors which were presented before the Measurements Section of the Institution of Electrical Engineers on 27th April (see *Electrical Review*, 30th April) was opened by Mr. A. C Lynch (P.O. Research Station). He suggested that while the main requirements of material for transductor cores were high permeability, sharpness of saturation, and reasonably low cost, it was important to know how best to measure the properties of these materials for the benefit of transductor makers.

The need for linearity of characteristic was not obvious. A material of extremely high slope might be better, to which some negative feedback could be applied. For instrument transductors a permeability which was reasonably constant with temperature was needed. The temperature coefficient of permeability varied a good deal with the exact composition of the material, and the composition of alloys should be very closely controlled.

Composite Cores

Dr. R. Willheim believed that Messrs. Frost-Smith and de Barr would probably agree that the initial permeability—the initial bend—had little or no meaning for an ordinary transductor, and so should have little place in a figure of merit. That had some bearing on a point raised by Mr. Lynch. A perfectly linear B/H loop was not so necessary as one in which the centre part remained perfectly linear. The authors referred to some potential advantages, mainly economic, from the use of composite cores, which were in the first instance associated with single-ended transductors. For push-pull transductors the case was slightly different because even if the individual transfer curves of the component transductors were non-linear the resultant push-pull curves would be perfectly linear. He agreed, however, in starting from a linear transfer curve, although all the instrument transductors would probably be in push-pull and would have a natural inherent linearity, because without this initial linearity the gain from a straight transfer curve was bias-dependent.

Milnes and Law mentioned the push-pull analysis of Butcher and himself as based on load-line technique. This was a misapprehension in that he and Butcher first gave a general and rigorous analytical treatment of push-pull circuits and then showed how to apply it graphically to load-line technique. He greatly favoured load-line technique, because at a glance it gave a wealth of co-ordinated information.

Mr. S. E. Tweedy (Ultra Electric) showed a slide of a load chart on which all the resistances, voltages and currents in the circuit were represented directly. Milnes and Law, he said, considered optimum circuit proportions, and, while he agreed that the ratios proposed were suitable for a general purpose amplifier, he felt that wide departure from them might be made where improvements of particular properties were desired at the expense of others. The graphical load-line method and that employed by the authors were complementary. The authors' method threw a useful light on the mechanism and the waveforms, while the graphical method was much easier to visualize and manipulate.

Mr. H. E. Wicks (N.P.L.) was disappointed that the authors' technique did not appear to be applicable to toroidal cores, which would be of importance if these transductors were going to be used in large quantities.

Milnes and Law had assumed a d.c. input, but the Admiralty had used a circuit in which, by reversing the direction of two of the main winding coils, an a.c. input could be used, which materially increased the impedance of the input circuit without affecting very much the gain or the time constant.

Mr. W. L. McPherson pleaded for the more widespread use of the non-dimensionalized transductor characteristic, which he had found could provide a very rapid solution to design problems. He doubted whether the saving in cost expected by Frost-Smith and de Barr from the use of a composite core would be an appreciable factor. For a standard transductor the core material probably cost about 35s, compared with a transductor cost of £10, so that the saving by reducing the quantity of high-quality material was unlikely to exceed 10 per cent. The composite core, however, should be useful for small input transductors.

Dr. E. H. Frost-Smith (Elliott Bros.) said that transductor circuits had been increasing in number and should now be classified in definite types. Since the auto-self-excited transductor used less copper and had therefore lower losses, was there any future for the self-excited transductor and, if so, where?

Mr. J. F. Coales (University of Cambridge) said that the bibliography of magnetic amplifiers contained over a thousand titles, but most of the original work had been done either in the U.S.A. or in Sweden. The originality shown in the two papers, therefore, had been very refreshing.

Time Constant

Dr. Ulrik Krabbe, of Copenhagen, in a written communication, pointed out that the time constant of the transductor was dependent on all the control windings, and since the main winding, with self-saturation rectifiers in series, made a closed circuit, it would also contribute to the time-lag. The influence was dependent on the fraction of time when both the self-saturation rectifiers were open and there was no reverse voltage across any of the rectifiers. To study this the voltage drop in the main winding from the small excitation current must be considered and it appeared that the reverse voltage angle was dependent on the resistance of the control winding. When it was infinitely large the reverse voltage angle was equal to $\pi - \alpha$ and when negligible it was 180 deg. The influence on the time constant of the main winding was therefore small.

Dr. E. H. Frost-Smith, replying to the discussion, agreed that the question of what was required in core material was very important, and emphasized the importance of the effect of losses, and in particular eddy current losses, which Mr. Lynch had not brought out, and which in square loop materials could completely mask the permeability.

Mr. A. G. Milnes, who also replied, criticized the idea of a uniform factor of merit which could be applied to all cores, pointing out that different core properties were required for different types of transductor. He had been impressed, he said, by the possibilities of the application of load-line technique to push-pull circuits. In reply to Dr. Frost-Smith, he thought that self-excited transductors had served their purpose but that the series transductor without self-excitation would continue to be used.

GENERATION AND DEVELOPMENT

B.E.A. Contracts

CONTRACTS HAVE been placed by the British Electricity Authority during the past month for power stations, transforming stations and transmission lines amounting in the aggregate to £11,027,990. The principal contracts include the following:—

Brunswick Wharf power station: High and low pressure pipework and valves.—C. A. Parsons & Co. 132 kV, 66 kV, 33 kV and auxiliary cables.—W. T. Glover & Co.

Deptford East station: 66 kV switchgear.—Metropolitan-Vickers Electrical Co.

Goldington station: 132 kV 2,500 MVA switchgear.—A. Reyrolle & Co.

Castle Donington station: Two 830,000 lb/hr boilers.—Babcock & Wilcox.

Nottingham station: Ash and dust handling plant.—B.V.C. Industrial Constructions.

Willington "A" station: Four circulating water pumps.—Drysdale & Co.

Hams Hall "C" station: 132 kV and auxiliary cables.—W. T. Glover & Co.

Carmarthen Bay station: 132 kV switch house.—Balfour, Beatty & Co.

Connah's Quay station: 3,000 V and 415 V auxiliary switchgear.—A. Reyrolle & Co.

Keadby station: High and low pressure pipework.—C. A. Parsons & Co.

Stella North station: Reinforced concrete cooling tower.—Davenport Engineering Co.

Chadderton station: Chimney.—P. C. Richardson & Co. (Middlesbrough).

Huncoat station: Superstructure.—William Moss & Sons.

Clyde's Mill station: Four 180,000 lb/hr boilers.—Yarrow & Co.

Dalmarnock station: Six 200,000 lb/hr boilers.—Yarrow & Co.

Iver substation: Site works.—J. L. Kier & Co.

Monk Fryston substation: Site and foundation works.—M. Harrison & Co. (Leeds).

Penwortham substation: Site and foundation works.—J. Gerrard & Sons.

Windscale substation: 132 kV 2,500 MVA switchgear.—Metropolitan-Vickers Electrical Co.

Hunshelf substation: 132 kV and 66 kV connections and ancillary equipment.—A. Reyrolle & Co.

Carlton Husthwaite substation: Two 15 MVA 132/11 kV transformers and earthing transformers.—Bruce Peebles & Co.

Spondon–Allerton–Winster: 132 kV overhead line.—Balfour, Beatty & Co.

Drakelow power station: 132 kV overhead line, Balfour, Beatty & Co.

Creyke Beck: 132 kV overhead lines.—Riley & Neate.

Rochdale: 132 kV overhead line.—British Insulated Callender's Construction Co.

Easy Payment System

The North Eastern Electricity Board has submitted to the Jarrow Town Council a plan by which Council house tenants would be able to pay their quarterly accounts by fortnightly payments. The Council proposes that 40 per cent of new houses shall have electric cooking facilities.

Overhead Supply to Littondale

Formal approval of a proposal to take electricity by overhead line up the Littondale Valley was given by Settle R.D.C. last week. The Council had previously advocated that the line should be placed underground in view of the high scenic value of the dale, or alternatively that underground cable should be used in the villages of Arncliffe and Hawkswick. The manager of the Bradford Sub-Area of the Yorkshire Electricity Board wrote regretting that the Board could not do this but gave an assurance that the proposed route had been most carefully selected and would not result in the lines being obtrusive.

Domestic Survey

More than a million domestic consumers in the area of the North Western Electricity Board are being asked to co-operate in an inquiry aimed at finding out how many electrical appliances are in use in the region. With their next power bills consumers will be asked to complete a special section listing the appliances they own, ranging from electric cookers and kettles to washing machines and refrigerators. An assurance that the information will in no way affect the charges which consumers have to pay for their supply has been given by the Board. The purpose of the inquiry is to assist the Board in planning its distribution system so as to ensure maximum economy and continuity of supply.

"All-Electric" Houses

Because a proposed experimental scheme for a combined hot water and central heating system for an old people's home and 36 houses has been found impracticable owing to the cost, Aberdeen Housing Committee has recommended that the houses should be "all-electric."

OVERSEAS

Power Resources of Labrador

The Premier of Newfoundland (Mr. Joseph Smallwood) announced last week that the British-Newfoundland Corporation had begun surveying the Hamilton River which, he said, had a power potential greater than that of the Niagara Falls. According to the St. John's correspondent of the *Financial Times*, Mr. Smallwood told the Newfoundland Legislature that an estimated 10 million h.p. could be developed from the Hamilton River's Grand Falls and its watershed. Both would be fully investigated. The Hamilton River project "could become the largest hydro development in the world."

Progress of Indian Projects

Reviewing work on power and irrigation projects in India during the past year the Finance Minister, Mr. C. D. Deshmukh, has expressed satisfaction at the general rate of progress; expenditure on the projects this year is expected to amount to about £150 million. Of the three big multi-purpose schemes, the Damodar Valley project seemed to have kept most nearly to its original schedule; two of its power stations were commissioned last year, the thermal one at Bokara having another of its 50 MW sets in operation. Hirakud, on the Mahanadi river, is still considerably behind schedule.

The Bhakra-Nangal development on the Sutlej in the Punjab, reputed to be one of the largest multi-purpose projects under construction in the world to-day, has had its two diversion tunnels completed and the foundation work for the 680ft high dam is expected to be started some time this year. The Ganguwal and Kotla power houses are under construction; when completed, each of these will generate 24 MW. The project, estimated to cost about £75 million, will irrigate 6·6 million acres and will generate about 400 MW. It will supply electricity to 128 towns and vast rural areas and provide power for 300 tube wells. Plans are also afoot for supplying energy across the border to West Junjab State in Pakistan.

Co. Donegal Scheme

An Irish concern, Malachy Burke (Contracts), Ltd., has been awarded the £350,000 civil construction contract for the Electricity Supply Board's Clady development in Co. Donegal. Previous contracts of this size have generally been placed with overseas firms. A dam 1,500ft long and 15ft high is to be built at Cung Lakes and another 50ft long and 25ft high across the Clady River. The plant will have a capacity of 5,000 kW.

Water Power in Formosa

Tenders are shortly to be called by the Taiwan Power Co. for the third unit of the hydro-electric project at Tien Leng, in central Formosa. This, the first of eight such projects, will be followed by a second at Ku Kwan, lower down the valley, for three units totalling 75,000 kW. The Tien Leng station is to have a capacity of 26,500 kVA.

Plant Extensions in Victoria

The Victorian State Electricity Commission expects to have nearly 170,000 kW of new generating plant in service by the end of this year—an increase of almost one-third on the present capacity. The principal new plant this year will be two 50,000 kW generators at the Yallourn power station. Work is nearing completion on three new steam-electric power stations at Geelong, Ballarat and Red Cliffs.

Financial Section

STOCKS and SHARES

HAVING been badly unsettled at times during April by international political developments, Stock Exchange markets began the current month on a much firmer note. A strong rally in the gilt-edged market was given the principal credit for a steadying of the ranks in the industrial market. In the electrical equipment section a further large instalment of final dividend and annual profits statements contained one or two corrections to over-optimism in advance of the news. But anticipations of an almost immediate reduction in Bank Rate were sufficiently strong to over-rule other considerations, and prices of British Government issues rose with a swing.

More Cable Dividends

Publication of final dividend and preliminary profits statements from Johnson & Phillips, Enfield Cables and London Electric Wire, practically completes a rather mixed list of results from the group of cable manufacturers. They relate to a year during which the resumption of free copper dealings evidently presented special problems to the industry. Although the Johnson & Phillips final payment applies this time to capital increased by last year's cash issue of shares, the company's decision to keep the total distribution unchanged at 15 per cent disappointed some of the more optimistic expectations, with the result of a fall of 4s 6d in the price of the £1 shares to 49s. The recession in profits leaves a net surplus of £190,000 to cover the £137,000 net amount of the ordinary dividend. At their present price the shares show a return of rather more than 6 per cent on the money.

London Electric Wire

The final dividend of 7½ per cent declared by London Electric Wire Co. and Smiths is payable on capital doubled by the share-for-share bonus of a few months ago. On the basis of the present capital the total for 1953 s equivalent to 10 per cent, and represents a 1½ per cent increase on the previous year's dividend. Trading profits are reported at an appreciably lower level than before, but tax liabilities have shrunk to a greater extent, with the consequence that the final net figure shows some improvement at £536,000. Preference and ordinary dividends absorb well under a quarter of that figure. This degree of conservatism is no doubt a factor in the still relatively modest yield of 4·6 per cent on the shares. They came back a little to 43s 6d after the announcement of the results. The price had previously climbed this year from 38s, and had put up one of the best performances in the electrical market over the past twelve months.

Price Changes

Principal movements last week in the electrical equipment market were

Week's Price Changes

Company or Board	Nom. Value	Middle price 3rd May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1954 Highest	1954 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	91		3	3	3 6 0	1	88⅝
Brit. Elec. 1974/77	100	90		3	3	3 6 1	90½	87½
Brit. Elec. 1976/79	100	96		3½	3½	3 13 0	97	93 11/16
Brit. Elec. 1974/79	100	105		4½	4½	4 1 0	105½	103 3/16
Overseas Electric Supply								
Calcutta Elec.	£1	20/-		6†	6†	6 0 0†	20/7	18/7
East African Power	£1	23/-		7	7	6 1 9	23/4	20/7
Nigerian Elec.	£1	23/6		10	10	8 10 3	25/-	23/6
Palestine Elec. "A"	£1	19/-		Nil	Nil	Nil	20/-	16/-
Perak Hydro-Elec.	£1	14/6		Nil		8 5 6	15/6	13/9
Equipment and Manufacturing								
Aberdare Cables	5/-	8/6	−3d	25	12½*	7 7 0	8/10	8/1
Aerialite	1/-	11/3		88⅛	88⅛	7 17 0	12/1	10/10
Allen, W. H.	£1	60/-	+2/-	15	15	5 0 0	60/-	50/-
Aron Elec. Ord.	£1	47/6	+2/6	15	20	8 8 6	47/6	43/-
Assoc. Elec. Ord.	£1	48/6		20	11½*	4 12 9	48/6	41/6
Automatic Tel. & El.	£1	68/9		15	15	4 7 3	68/9	62/9
Babcock & Wilcox	£1	52/-	−5/-	18	12*	4 12 3	57/-	47/3
Baldwin, H. J.	2/-	4/-		20	20	10 0 0	5/6	3/9
Bakelite	10/-	25/9		12½	12½	4 17 0	27/6	23/6
British Aluminium	£1	34/6	−1/9	12	10	5 16 0	40/-	34/6
B.I. Callender's	£1	41/-	−1/3	10	10	4 17 7	44/-	37/9
B.I. Callender's 6% Pref.	£1	26/-		6	6	4 12 3	26/-	24/3
British Thermostat	5/-	22/6		30	35	—	22/6	17/6
British Vac. Cleaner	5/-	12/6	+1/-	25	25	10 0 0	14/6	11/6
Brook Motors	10/-	36/6		20	20*	5 9 6	36/6	33/3
Brush Ord.	5/-	6/-	−9d	4	6	5 0 0	7/-	3/6
Bulgin, A. F.	1/-	3/3		30	30	9 4 6	3/7	3/2
Burco	5/-	13/9		35	35	6 7 3*	13/9	12/1
Chloride El. Storage	£1	54/6		20	12½*	4 11 9	57/9	46/6
Clarke Chapman	£1	75/9		17½	20	5 6 8	77/6	71/3
Cole, E. K.	5/-	27/-		25	25*	4 12 7	27/-	22/6
Cossor, A. C.	5/-	8/-		10	10	6 5 0	8/11	7/-
Crabtree	10/-	25/3	−6d	17½	17½	6 18 6	27/9	23/9
Crompton Parkinson Ord.	5/-	17/-	+6d	11½	20	5 17 9	17/-	14/-
De La Rue	5/-	13/-		35	Nil	Nil	14/10	12/3
Decca	4/-	36/-	+6d	150	35*	—	37/10	28/9
Desoutter	5/-	18/3		18	20	5 9 6	18/7	16/1
Dewhurst	2/-	5/6		19	19	6 18 3	6/3	5/1
Dictograph Tel.	2/-	6/-		20	20*	6 13 4	6/3	5/2
Dubilier Condenser	1/-	5/-		28	25*	5 0 0	5/1	4/1
E.M.I.	10/-	14/-		12	8	5 14 4	14/9	11/3
Electrical Components	5/-	11/3		20	20	8 17 10	11/6	10/9
Elec. Construction	£1	58/9		15	15	5 2 3	58/9	53/-
Enfield Cable Ord.	£1	18/9	−1/3	5	Nil	Nil	22/3	16/6
English Electric	£1	43/9		15	10*	4 11 4	44/6	38/-
English Electric 3½% Pref.	£1	16/6		3½	3½	4 11 0	16/6	15/3
Ericsson Tel.	5/-	24/3		22†	25†	2 11 6*†	24/10	22/9
Ever Ready	5/-	36/3	+3/9	35	40	5 16 4	36/6	26/-
Falk Stadelmann	£1	38/9	−1/3	15	15	7 14 9	41/-	36/6
G.E.C. Ord.	£1	42/6		22½	11½*	5 6 0	43/9	37/6
G.E.C. 6½% Pref.	£1	27/-		6½	6½	4 16 3	27/3	26/6
General Cables	5/-	16/9		30	30	8 19 2	16/10	16/6
Greenwood & Batley	£1	43/9		15	17½	8 0 0	44/-	40/3
Hackbridge Cable	5/-	14/-	+6d	20	20	7 2 9	14/-	11/3
Hackbridge & Hewittic	5/-	19/3		20	20	5 4 0	19/6	16/10
Hall Tel. Acc.	10/-	11/-		10	10	9 1 9	11/11	10/7
Heatrae	2/-	4/3		12½	12½	5 17 9	4/3	4/-
Henley's	10/-	17/6	−6d	10½	10½	6 0 0	18/3	15/6
Holophane	5/-	14/9		20	20	6 15 7	15/-	13/1

* After capital bonus. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

mostly connected with individual company news. In addition, J. Lucas shares, which have been active since the recently declared increase in the interim dividend, came into renewed favour with an improvement of 1s 3d to 62s 6d. Gains of 2s or more were recorded in W. H. Allen, C. A. Parsons, Aron and Southern Areas: the last-named company is expected to announce the annual results on 12th May. Ever Ready added 3s 9d to the rise which, in the week before, had accompanied the restoration of the dividend to 40 per cent, and Crompton Parkinsons continued on their upward path to 17s. On the reverse tack, Reyrolle, Telegraph Constructions, Plessey and Metal Industries lost a part of their previous advances.

Electrical Investments

Company or Board	Nom. Value	Middle price 3rd May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1954 Highest	1954 Lowest
Equipment and Manufacturing—continued.								
Hoover	5/-	31/6		25	45	7 2 9	34/3	26/3
I.C.I.	£1	60/3		13	15	4 19 6	60/3	52/9
Intl. Combustion	5/-	22/6		15	20	4 9 0	22/6	14/6
Johnson & Phillips	£1	49/-	−4/6	15	15	6 2 6	52/3	48/9
Lancashire Dynamo	£1	50/9		12½	14	5 10 3	50/9	43/-
Laurence, Scott	5/-	18/9		15	20	5 6 8	18/9	14/-
Lister, R. A.	£1	40/-		9	12	6 0 0	40/-	31/9
London Elec. Wire	£1	43/6	−3d	15	10*	4 12 0	43/9	38/-
Lucas, J.	£1	62/6	+1/3	9½	10⅝	3 9 6	64/4	50/3
Marryat & Scott	2/-	6/6		22½	22½	6 18 6	6/6	5/11
Mather & Platt	£1	64/-		12½	15	4 13 9	64/-	53/1
Metal Industries	£1	34/3	−9d	15	12*	7 0 0	42/3	29/6
Midland Elec. Mfg.	£1	66/3	+2/6	15	15	4 11 0	65/7	63/-
Morphy-Richards	4/-	16/-	−1/-	40	40	—	17/-	11/4
Murex	£1	55/-	−1/3	15	15	5 9 0	56/3	50/-
Newman Ind.	2/-	2/3		10	10	8 17 9	2/6	2/-
Oldham & Son	1/-	3/-		35	17½*	5 16 8	3/4	2/5
Parnall (Yate)	5/-	5/9	−3d	6	8	6 13 4	6/6	4/3
Parsons, C. A.	£1	48/9	+2/6	12½	7½	3 1 6	48/9	38/1
Plessey	5/-	48/9	−1/9	25	30	3 1 6	53/-	37/10
Pye Deferred	5/-	22/-	−6d	18	20	—	24/-	15/7
Revo	10/-	17/6		27½	27½	—	17/9	16/7
Reyrolle	£1	77/6	−2/6	12½	13¾	3 11 0	80/-	66/-
Rheostatic	4/-	12/-		19	20	6 13 4	12/9	11/-
Richardsons Westgarth	5/-	12/3		12	15	6 2 6	12/3	8/7
Scottish Cable	4/-	14/6		32	20*	4 11 6	14/6	12/11
Siemens Ord.	£1	43/9		10	10	5 6 8	43/9	34/9
Smith (England), S.	4/-	9/6	−3d	12½	15	—	9/11	7/8
Southern Areas	£1	20/-	+2/-	5	6	6 0 0	20/-	17/6
Strand Elec.	5/-	8/3		17½	17½	10 12 3	9/3	8/6
Sturtevant	5/-	35/6	+6d	18·1†	18·9*†	2 13 3†	35/6	29/-
Sun Elec.	£1	27/6		15	15	10 18 3	28/9	27/6
Switchgear & Cowans	5/-	12/6		22½	10	4 0 0	13/7	9/9
Taylor Tunnicliff	5/-	11/-		25	12½*	5 13 9	12/4	10/7
T.C.C.	10/-	58/9		20	30*	5 2 3	60/-	42/3
T.C. & M.	£1	32/-	−1/-	10	8½*	5 6 3	34/6	30/3
Telephone Mfg.	5/-	7/9	−3d	10	10	6 9 0	8/6	7/6
Thorn Elec.	5/-	17/-		12½	12½	3 11 5	17/6	13/3
Thornycroft	£1	36/3		15	15	8 5 6	37/3	33/4
Tube Investments	£1	63/9	−1/3	15*	15	4 14 0	68/9	60/3
Vactric	5/-	11/3		Nil	Nil	Nil	11/3	7/6
Veritys	5/-	6/6		10	12½	9 12 3	8/3	5/-
Walsall Conduits	4/-	50/-		70	70*	5 12 0	50/-	44/-
Ward & Goldstone	5/-	46/3		45	45*	4 17 3	46/3	41/3
Watford	2/-	6/3		25	22½*	—	6/3	4/7
Westinghouse Brake	£1	67/6		14	15	4 9 0	68/10	60/9
West, Allen	5/-	14/6		15	17½	6 0 9	15/3	12/7
Wolf Electric	5/-	12/3	−3d	15	17½	7 2 9	13/10	11/-
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A Ord.	100	82½		—	6	7 5 5	89½	82
Ord.	100	55½		—	3½	6 15 3	55½	52
Anglo-Portuguese	£1	22/6		8	8	7 2 2	23/4	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	44/-	−1/-	25	35	3 19 6	45/1	39/1
Cable & Wireless:								
Ord.	£1	39/6	−1/-	8	9	4 11 3	40/6	26/2
4% Loan	100	96½		4	4	4 3 0	98	95½
Calcutta Trams	£1	17/6	−1/-	6†	2½†	—	19/3	17/1
Cape Elec. Trams	£1	14/6		5½	5½	7 11 9	15/3	12/4
Falconi Marine	£1	31/3	+1/3	10	10	6 8 0	31/3	27/6
Oriental Tel. Ord.	£1	73/9	−1/3	16	16	—	80/6	73/9
Telephone Props.	£1	5		8	8	—	5⅛	4½
Telephone Rentals	5/-	10/-		10	10*	—	10/-	9/1

Enfield Cables Results

Enfield Cables £1 shares, quoted at 18s 9d, were not greatly affected by the publication of the results for the past year. These were in line with expectations formed on the company's statement at the time of last November's decision to pass the interim ordinary dividend. It was then said that losses on the Brynmawr Rubber subsidiary were likely to absorb the greater part of the profits on the cable business. This is now shown to have been the case, the group profit being struck at £57,000 after providing for losses of £239,000 on that account. No dividend is proposed this time. An accompanying announcement reports that an offer of £750,000 in cash by Dunlops for the Brynmawr business has been accepted.

Dividend Disappointments

Babcock & Wilcox are reducing the rate of the final dividend in exact proportion to the increase in the capital ranking for it as a result of the recent 50 per cent share bonus. In other words, the amount of money actually distributed is the same as before. Shareholders had been advised at the time of the bonus that it did not necessarily carry any dividend implications, but this did not prevent a sharp setback in the price of the shares when the warning proved to have been more than a formality. The quotation was marked down from 57s to 52s. An unchanged dividend of 15 per cent for the year from Automatic Telephone & Electric also fell short of some expectations, the price of the ordinary shares reverting to 68s 9d, after an anticipatory rise, despite the excellent earnings figures and the proposal of a 10 per cent share bonus.

Other Points

Switchgear & Cowans 5s shares have picked up to 12s 6d since last month's initial reaction to the reduction in the dividend to 10 per cent. The 5s shares of the Electrical Apparatus Company, which now declares a 7½ per cent interim dividend, are quoted at 12s 6d.

Brush Electrical Engineering 5s shares were quoted around 6s after the appearance of the full report. They have fluctuated this year between extremes of 3s 6d and 7s. The accounts confirm earlier calculations, from the preliminary profits statement, that the 6 per cent dividend is covered more than twice by the normal earnings of the business, leaving out of account the losses on the Indian tube-well contracts. These have been taken care of by transfers from reserves, and the subsidiary concerned is to cease operations.

REPORTS and DIVIDENDS

The Brush Electrical Engineering Co., Ltd.—The report and accounts for 1953 now issued confirm the preliminary figures given in our issue of 2nd April. In their report the directors state that the entry of the group into Indian tube wells was conceived as a means of developing a new market for diesel - electric generating station and transmission equipment. Initially this concept was justified and substantial orders were received. During the year under review only a small amount of orders was received through the efforts of Associated Tube Wells, Ltd., and it now appears unlikely that the tube well operation will ensure a large outlet for the group's normal products. The directors have therefore decided to terminate, on the completion of existing contracts, the tube well operation. The Indian tube well losses for 1953 amounted to £418,814, and with taxation relief, the net loss is £159,877.

In his statement, Sir Ronald W. Matthews (chairman) says that the Loughborough factory has had another successful year. The turbine reconstruction programme for the B.E.A. is complete. The range of alternators has been improved by the " Amplidex " system of voltage control, and the range of flameproof motors has been expanded to 150 b.h.p. A new 250 MVA switchfuse for voltages up to 11 kV has been developed.

Referring to the progress of the various companies in the group, the chairman says that at the Cardiff factory of the Hopkinson Electric Co., Ltd., a range of " Square Path " alternators involving a radical change in design has been developed and marketed during 1953. The feature of the year's trading of Petters, Ltd., is the increase in home sales to manufacturers who incorporate Petter engines in contractors' and agricultural plant. The home demand for 55 kW diesel-electric generating sets manufactured by J. & H. McLaren, Ltd., has dwindled, but steps are being taken to fill the gap in production capacity with a new range of low-powered generating sets and a newly-designed medium diesel engine. The market for small horizontal diesel engines made by the National Gas & Oil Engine Co., Ltd., has fallen off considerably, but has been compensated for by an increased demand for vertical engines. The success of the new range of engines of Mirrlees, Bickerton & Day, Ltd., has been remarkable; particularly that of the largest unit, an engine of 3,000 b.h.p. Vivian Engine Works, Ltd., has turned a loss in 1952 into a profit for 1953.

At the end of the year the volume of orders on the books was sufficient to ensure reasonable employment in the factories in 1954. The net intake of new orders both for the home and export markets exceeded the figures of 1952 and the year closed with an improved trend which was maintained during the first quarter of 1954.

The London Electric Wire Co. & Smiths, Ltd.—The group profit for 1953, before taxation, is £1,076,520, as compared with £1,307,110 for the preceding year. Taxation requires £570,074, and after crediting tax adjustments relating to previous years of £29,949, and deducting costs of £5,673 in respect of bonus issue, the net balance is £530,722 (against £510,580). General reserve receives £379,070, and employees' general benefit reserve £34,158. It is proposed to pay a final dividend of 7½ per cent on the ordinary stock, which, with the interim of 5 per cent paid before the 100 per cent free scrip issue, makes a total equivalent to 10 per cent on the present ordinary capital of £2,000,000. For the previous year the distribution was 15 per cent which included a Coronation bonus of 5 per cent.

The Automatic Telephone & Electric Co., Ltd., in a preliminary statement, shows a group profit for 1953 of £1,441,393, as compared with £1,137,917 for the previous year, and after providing £763,963 for taxation, a net balance of £677,430 (against £538,763), of which £677,028 is applicable to the parent company. General reserve receives £98,390, research reserve £199,774, and employees' reserve £63,768. It is proposed to pay a final ordinary dividend of 12 per cent, again making 15 per cent for the year, and to carry forward £617,018 (against £490,932 brought in).

It is also proposed to make a free scrip issue which will take the form of one new £1 ordinary share for each £10 of ordinary and/or deferred stock held.

Enfield Cables, Ltd.—A decline in group profits from £404,858 to £57,494 is reported for 1953, and after deducting £40,735 for taxation, the net balance is £16,759 (against £161,921), to which is added £1,399 profit on sale of investments. No ordinary dividend is proposed for the year (against 5 per cent). The balance carried forward is £98,681 (against £101,007 brought in). The group profit is after absorbing the losses of Brynmawr Rubber, Ltd., and its subsidiaries, amounting to £238,985. The directors announce that an offer of £750,000 in cash by the Dunlop Rubber Co., Ltd., for the whole of the share and loan capital of Brynmawr Rubber, Ltd., has been accepted.

Johnson & Phillips, Ltd.—The accounts for the year ended 31st December last show a consolidated trading profit of £602,299, as compared with £706,366 for the preceding year, to which is added £24,871 income from trade investments and £132 transfer fees, making £627,301. After meeting all charges, including £235,000 for taxation, the net profit is £214,018 (against £285,656), to which is added £154,314 brought in, making £368,332 available. It is proposed to place £50,000 to research and development reserve and to pay a final dividend of 7½ per cent, making 15 per cent for the year (unchanged), on capital increased from £1,333,750 to £1,667,187 by a " rights " issue a year ago. The balance carried forward is £156,036.

The Scottish group shows a trading balance of £6,021 (against £15,696), and after making various provisions and paying the preference dividend, the balance carried forward is £57,222 (against £65,093 brought in).

Babcock & Wilcox, Ltd., report a group profit, excluding two foreign subsidiaries, for 1953 of £4,149,618, as compared with £4,605,018 for 1952, and after allowing £2,612,415 for taxation, the net balance is £1,537,203 (against £1,345,698), of which £1,517,537 is attributable to the parent company. To this is added capital profits of £53,736. It is proposed to pay a final dividend of 7 per cent on the £7,524,398 ordinary stock. With the interim of 7½ per cent paid on the £5,016,265 ordinary stock before the 50 per cent scrip issue, the distribution is equivalent to the 18 per cent (including 3 per cent bonus) paid on the smaller capital for 1952.

Wm. Sanders & Co. (Wednesbury), Ltd., report a profit for 1953 of £18,409, as compared with £28,804 for 1952. Of this taxation absorbs £11,313 (against £16,807). It is proposed to pay an ordinary dividend of 15 per cent for the year (against 20 per cent).

T. Clarke & Co., Ltd.—The consolidated net profit for 1953 is £12,111 (against £10,391 for 1952), after deducting £24,840 for taxation. The dividend for the year is maintained at 18 per cent by a final payment of 9 per cent. The balance carried forward is £13,631 (against £12,170 brought in).

The Electrical Apparatus Co., Ltd., has declared an interim dividend of 7½ per cent. In making the announcement, the directors state that it must not be assumed that the total distribution for the year will be more than the 20 per cent forecast last December when the ordinary shares were introduced to the London market. Last year there was one payment of 20 per cent on ordinary capital of £250,066.

Broadcast Relay Service, Ltd.—The British Electric Traction Co., Ltd., which is already substantially interested in the company, is providing over £500,000 of new capital for the development of wired television. Broadcast Relay Service has formed a new subsidiary, Rediffusion Vision,

Ltd., the original issued capital of which was £45,000 ordinary £1 shares. The Treasury has consented to the issue of additional shares of a nominal value of £1,015,000. The issue has been made at par to the British Electric Traction Co., Ltd., and consists of 15,000 £1 ordinary shares and 1,000,000 6 per cent cumulative preference shares of £1 each, 10s paid up.

Glenfield & Kennedy, Ltd.—The directors estimate that £400,000 of additional capital will be required in the immediate future, and to meet this they propose to reorganize the existing preference capital and to offer 395,000 5½ per cent cumulative preference £1 shares to stockholders for cash. It is also proposed to acquire the preference shares of its subsidiaries, Alley & MacLellan and J. Blakeborough & Sons and the remaining ordinary shares of its subsidiary, Blackett Hutton & Co., involving the issue of a further 295,000 of new 5½ per cent preference £1 shares.

The reorganization of the existing preference capital will involve the conversion of the existing £100,000 4½ per cent "A" (tax free) preference stock and the £100,000 7½ per cent "B" preference stock into one class of 200,000 5½ per cent preference £1 shares. A further 110,000 5½ per cent preference would be issued fully paid (by way of capitalization of reserves) to holders of the "A" and "B" preference stock in the proportions of three for every £5 "A" stock and one for every £2 "B" stock. Thus, the board states, preference stockholders would receive an increase in income and in the nominal value of their shareholdings in return for their consent to the scheme.

If all the proposals are put into effect the 5½ per cent preference capital will amount to £1,000,000.

New Companies

Anchor Cable Co., Ltd.—Registered 28th April. Capital £2. Objects: To carry on the business of manufacturers of and dealers in insulated cables and wires for the transmission of electrical energy, etc. Directors: J. P. Hourston, Fetcham, director of Electric Power & Communications Trust, Ltd., and Commercial Secretaries, Ltd., and W. H. Wells. Regd. office: Norfolk House, Norfolk Street, W.C.2.

Norman Bethell, Ltd.—Registered 3rd April. Capital £3,000. To construct railways, tramways, gas and electricity works, waterworks, roads, bridges, etc. Directors: R. C. N. Bethell and Ethel Bethell. Regd. office: 75, Cecil Avenue, Sale, Ches.

Richardson Electrics (Doncaster), Ltd. Registered 6th April. Capital £1,000. Electrical engineers and general electrical installation contractors, etc. Directors: G. C. Richardson and Prosper F. DeMulder. Regd. office: 1, Ings Road, Doncaster.

Lancasters Electricians (Brighton), Ltd.—Registered 6th April. Capital £1,000. To acquire the business of an electrical contractor carried on by Victor Lancaster at 96, Preston Road, Brighton, etc. Directors: V. Lancaster and R. Challice. Regd. office: 29, Addison Road, Hove.

Winstanley Electric, Ltd.—Registered 6th April. Capital £100. Manufacturers, importers and exporters of and dealers in electrical apparatus, appliances and fittings, radio and television apparatus and appliances, etc. Directors: A. Winstanley, T. C. Winstanley, E. Winstanley and E. Winstanley, sen. Regd. office: 28, Old Hall Road, Gatley, Cheadle, Ches.

Increases of Capital

National Electric Construction Co., Ltd.—Increased by £1,070,000 in 555,000 5 per cent cumulative redeemable preference shares of £1 and 740,000 ordinary and 290,000 undesignated shares of 10s, beyond the registered capital of £185,000.

Midland Electric Installation Co., Ltd.—Increased by £25,600 in 83,200 "A" and 19,200 "B" shares of 5s, beyond the registered capital of £5,000.

Synchronome Co., Ltd.—Increased by £18,600, in £1 ordinary shares, beyond the registered capital of £7,000.

James McKenzie, Ltd.—Increased by £20,000, in £1 7 per cent redeemable preference shares, beyond the registered capital of £10,000.

Liquidations

T. G. Brunskill, Ltd., radio and electrical engineers.—Special resolution passed (pursuant to sections 141 (2) and 278 (1) (b) of the Companies Act, 1948), that the company be wound up voluntarily. Liquidator, Mr. D. R. B. Broom, 1, North Place, Cheltenham, appointed 14th April.

Mead Electric Co., Ltd.—Meeting 28th May at 4, Buckingham Gate, London, S.W.1, to receive an account of the winding-up by the liquidator, Mr. J. R. M. Valentine.

Bankruptcies

C. H. Sanders, electrician, lately carrying on business at 132, Florence Road, Smethwick, Staffs.—Receiving order made 14th April on a creditor's petition.

H. Pryor, 36, Low Hill, Liverpool, 6, electronic engineer.—Public examination 1st June at the Court House, Fruit Exchange Buildings, Victoria Street, Liverpool.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to dates mentioned:—

14th May

NOBRAC (design). No. 721,587, Class 7. Electric dynamo brushes made wholly or principally of carbon.—Nobrac Carbon Co., Ltd., Vale Works, Vale Road, Portslade, Sussex.

MANGANAC. No. 724,254. Class 9. Electric welding electrodes made of manganese alloys.—Rockweld, Ltd., Commerce Way, Croydon.

CANDA (design). No. 727,383, Class 9. Malleable iron electrical conduit fittings.—F. Holford, K. Cornfield, D. Holford and C. Cornfield, trading as Cornfield & Aldridge, 19, Spout Lane, Walsall.

CORRUSTALUM. No. 727,443, Class 9. Electric cables and insulated electric wire, all being aluminium sheathed.—Wandleside Cable Works, Ltd., 106, Garratt Lane, Wandsworth, London, S.W.18.

SLEEKHEAT. No. 726,053, Class 11. Electric heating apparatus.—Premier Electric Heaters, Ltd., Premier Works, Keeley Street, and St. Andrew's Road, Birmingham.

21st May

PYE. No. B719,323, Class 9. No. B719,324, Class 11. Domestic electrical appliances and parts.—Pye, Ltd., Radio Works, St. Andrew's Road, Cambridge.

No. B726,419 (design), Class 9. Electric suction cleaners and parts and fittings included in Class 9.—Vacuum Cleaners & Electrical Supplies, Ltd., 20–22, Gypsy Hill, London, S.E.19.

School Meals Catering

THE purchasing of electrical equipment was the subject of a talk given on 1st May by Mr. E. M. Ackery, of the British Electrical Development Association, at a School Meals Conference at Cheltenham, organized by the Institutional Management Association.

Mr. Ackery said that now the Ministry of Works' pool of catering equipment was no longer available, three possible alternatives might be considered:—(1) That the local authority framed its own specification; (2) that the Ministry of Works' standards should be adopted; or (3) that manufacturers' standard equipment should be used. It seemed that there would be little object in local authorities framing their own new specifications. A host of different specifications placed the manufacturer in a very difficult position; delivery periods would be long and prices unduly high.

Under the old system the Ministry of Works purchased various items of equipment in large numbers and although the equipment was in many cases non-standard the manufacturers were able to quote reasonable prices because the quantities were large. If, however, equipment to this specification was ordered in "penny numbers," it was not to be expected that the prices would be the same.

Moreover, there was the question as to whether the Ministry's specification, or indeed any one specification, provided the most suitable equipment for every particular instance. Equipment should be chosen to suit the requirements of the kitchen, and these requirements should never be subordinated to equipment that happened to be available under a specification. In many respects the abandonment of the pool meant that schools were free to plan their kitchens entirely from the point of view of efficiency and service.

Mr. Ackery described the various types of electrical equipment available for installation in school kitchens, gave a number of useful hints on the choice of equipment for catering for a given number of meals, and also referred to the electricity consumption of some typica installations.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 16th June from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

15848. Simplex Electric Co., Ltd.—System for controlling the temperature of electric and other heaters. 21st June, 1951. (710491.)

29913. London Electricity Board and Baggott, A. J.—Methods of and means for calibrating electricity meters. 6th December, 1951. (710488.)

30897. British Thomson-Houston Co., Ltd.—Control of electric motors driving winding engines, hoists and the like. 16th August, 1951. Addition to 577183 and 624684. (710696.)

31488. British Thomson-Houston Co., Ltd.—Magnetic torque measuring devices. 28th December, 1950. (710644.)

1951

3642. Barnsley & Sons, Ltd.—Electric motors. 15th May, 1952. (710646.)

4751. Evans, D. D.—Electric heating appliances. 26th May, 1952. (710647.)

6682. Staatsbedrijf de Posterijen, Telegrafie en Telefonie.—Signal storing device for telegraph and like systems. 20th March, 1951. (710700.)

7128. British Insulated Callender's Cables, Ltd.—Manufacture of conductive rubber and conductive rubber articles. 7th February, 1952. (710701.)

7306. Vlk, H.—Electroplating of aluminium or its alloys. 29th March, 1951. (710758.)

8487. Standard Telephones & Cables, Ltd.—Thermionic cathodes. 4th April, 1952. (710648.)

11329. Patelhold Patentverwertungs- & Elektro-Holding Akt.-Ges.—Pulse multiplex communication systems. 15th May, 1951. (710760.)

17499. British Thomson-Houston Co., Ltd.—Electric control systems. 24th July, 1951. (710764.)

19172. Smit & Co.'s Transformatoren-Fabriek N.V., W.—Welding transformer switching circuits. 14th August, 1951. (710767.)

19187. Garner, F. H., Nutt, C. W., and Mohtadi, F.—Electrostatic oil filters. 7th August, 1952. (710561.)

20005. Bottke, H.—Electric incandescent signal lamps. 24th August, 1951. (710768.)

21569. Cianchi, A. L. G.—Insulated wires and electric motors and other electrical devices. 9th December, 1952. (710711.)

23948. National Research Development Corporation.—Measurement of peak amplitudes of very short electrical pulses. 5th January, 1953. (710514.)

24121. Metropolitan-Vickers Electrical Co., Ltd.—Electronic switching circuits. 14th October, 1952. (710717.)

25981. Kelvin & Hughes, Ltd.—Electric pulse generators. 2nd October, 1952. (710658.)

26439. British Thomson-Houston Co., Ltd.—Electric induction apparatus. 17th September, 1952. (710719.)

27530. Svenska Aktiebolaget Gasaccumulator.—Electric arc stud welding or soldering guns. 23rd November, 1951. (710722.)

27892. Soc. Anon. A. Citroen.—Device having the dual function of electromagnetic clutch and alternator. 28th November, 1951. (710662.)

29025. Compagnie Générale de Télégraphie sans Fil.—Ultra-high-frequency transmission systems. 11th December, 1951. (710665.)

29026. Marconi's Wireless Telegraph Co., Ltd.—Amplitude modulated carrier wave transmitters. 11th December, 1951. (710666.)

29126. Siemens-Schuckertwerke Akt.-Ges.—Arrangements for controlling electrically-driven machines. 12th December, 1951. (710784.)

29859. Standard Telephones & Cables, Ltd.—Arrangement for improving the contrast of luminous screen images. 20th December, 1951. (710786.)

29888. Mallory & Co., Inc., P. R.—Variable electric resistances. 20th December, 1951. (710668.)

29991. Vickers-Armstrongs, Ltd., and Wightman, E. J.—Electrical apparatus arranged to have an a.c. output. 28th November, 1952. (710726.)

1952

195. Naimer, H.—Cam-operated electrical switches. 2nd January, 1952. (710788.)

470. Philips Electrical Industries, Ltd.—Short-wave therapy apparatus. 7th January, 1952. (710669.)

3457. Automatic Telephone & Electric Co., Ltd.—Telephone or like systems. 27th January, 1953. (710798.)

4184. Kaiser, A. F.—Small electric motors, in particular rotating field motors. 18th February, 1952. (710799.)

7320. Western Electric Co., Inc.—Photo-electric devices employing semi-conductive bodies. 21st March, 1952. (710804.)

7750. Philips Electrical Industries, Ltd.—Electric discharge tubes for use at very high radio frequencies. 26th March, 1952. (710462.)

8955. Elmeg - Elektro - Mechanik Ges.—Electromagnetic hammer. 8th April, 1952. (710464.)

9802. Philips Electrical Industries, Ltd.—Electric-discharge tube having a hydrogen atmosphere and a hydrogen replenisher. 18th April, 1952. (710593.)

10544. Siemens-Reiniger-Werke Akt.-Ges.—Image-forming reflector systems more especially for X-rays. 25th April, 1952. (710465.)

10652. British Thomson-Houston Co., Ltd.—Dynamo-electric machines. 28th April, 1952. (710682.)

10657. Aktiebolaget Eksjoverken.—Device for electric rail brakes. 28th April, 1952. (710809.)

11339. Escher Wyss Maschinenfabrik Ges.—Tidal power installations. 5th May, 1952. (710685.)

11634. Kollsman Instrument Corporation.—Pressure-responsive electric switch. 8th May, 1952. (710743.)

12428. Borg-Warner Corporation.—Electric control mechanism. 16th May, 1952. (710541.)

13943. Sertillange, M.—Method of and means for making electrical connections. 3rd June, 1952. (710471.)

14314. Standard Telephones & Cables, Ltd.—Voice frequency signalling system. 6th June, 1952. (710600.)

14842. Philips Electrical Industries, Ltd.—Electrical amplifying circuits. 12th June, 1952. (710473.)

16398. Compagnie Générale d'Electricite.—Apparatus for high frequency measurement of the characteristics of symmetrical transmission lines. 30th June, 1952. (710609.)

17145. Westinghouse Brake & Signal Co., Ltd., and Walker, A. H. B.—Stand-by systems for d.c. power supplies. 18th May, 1953. (710477.)

17397. Westinghouse Air Brake Co.—Pendulums for electrical relays for code signalling systems. 10th July, 1952. (710823.)

17692. Erie Resistor Corporation.—Temperature and voltage control capacitors. 14th July, 1952. (710612.)

19015. General Electric Co.—Electric heating units. 28th July, 1952. (710546.)

19124. Allmanna Svenska Elektriska Aktiebolaget.—Device for maintaining a carrier current communication on a power line which is simultaneously effectively earthed. 29th July, 1952. (710547.)

20584. Standard Telephones & Cables, Ltd.—Selenium rectifiers. 15th August, 1952. (710812.)

21044. Kristensen, J. C.—Electric hedge and like cutters. 21st August, 1952. (710551.)

21463. Raytheon Manufacturing Co.—Electron-discharge devices. 26th August, 1952. (710552.)

21765. General Electric Co.—Over-voltage protected induction apparatus. 29th August, 1952. (710620.)

23237. Philips Electrical Industries, Ltd.—Radio receivers. 16th September, 1952. (710834.)

23368. Moore Electronic Laboratories, Inc.—Circuit for the automatic control of vehicle headlamps. 17th September, 1952. (710835.)

24125. Bosch Ges., R.—Speed regulators for electric motors. 26th September, 1952. (710836.)

24331. Philips Electrical Industries, Ltd.—Rectifying installations comprising two or more gas-filled or vapour-filled discharge tubes traversed by current in series. 29th September, 1952. (710626.)

25436. Standard Telephones & Cables, Ltd.—Electric pulse rectifier circuits.—10th October, 1952. (710839.)

25966. International Business Machines Corporation.—Electronic storage device. 16th October, 1952. (710554.)

26208. Telefunken Ges. für Drahtlose Telegraphie.—Arrangements for deflecting the electron beam of a cathode-ray tube. 20th October, 1952. (710629.)

27387. Allmanna Svenska Elektriska Aktiebolaget.—Transductor regulators. 31st October, 1952. (710843.)

28285. Laukvik, H.—Electrode holders for electric arc welding. 10th November, 1952. (710845.)

28691. Siemens & Halske Akt.-Ges.—Electro-magnetic wave-guides. 13th November, 1952. (710847.)

31851. British Thomson-Houston Co., Ltd.—A.c. electric protective arrangements. 16th December, 1952. (710850.)

1953

19830. Simplex Electric Co., Ltd.—Control systems for electric heaters. 21st June, 1951. Divided out of 710491. (710560.)

New Scottish Television Station

A contract for building work at the new medium-power television transmitting station at Meldrum, Aberdeenshire, has been placed with Alexander Hall & Son (Builders), Ltd., of Aberdeen. The contract covers the main station building, service roads, etc.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—MELBOURNE.—12th May. State Electricity Commission of Victoria. Disc insulators. (E.S.B. 10631/54. Ten/9101 and E.S.B. 10761/54. Ten/9114.)*

31st May. Melbourne & Metropolitan Tramways Board of Victoria. Rectifier equipment components. (E.S.B. 10601/54. Ten/9095.)* 15 manually operated 6,600 V oil circuit breakers. (E.S.B. 10530/54. Ten/9094.)*

Belfast.—10th June. Electricity Department. Extension of ash handling plant at Power Station West. (See this issue.)

17th May. Northern Ireland Housing Trust. Electrical installations in 400 houses at Larne, Co. Antrim. Offices of the Trust, 12, Hope Street.

27th May. Down County Education Committee. Electrical installation at Ballywalter meals kitchen, Ballywalter, Co. Down. Offices of the Committee, 1, Wellington Place.

Birmingham. — 19th May. City Council. Street lighting equipment for one year from 1st July next. (See this issue.)

Bury St. Edmunds.—31st May. Corporation. Street lighting equipment. (See this issue.)

Cannock.—26th May. U.D.C. Two 900 g.p.m. centrifugal recirculation pumps, and float switchgear for extensions to main sewage disposal works. E. Lomax, surveyor, Council Offices, The Green.

Egypt.—CAIRO.—25th May. Cairo Electricity and Gas Administration. Transformer equipment. (E.S.B. 10877/54. Ten/9119.)*

15th June. State Telegraphs and Telephones Administration. Transmitting and receiving equipment for two radio stations. (E.S.B. 10550/54. Ten/9091.)*

India.—MADRAS.—15th May. Electricity Department, Government of Andhra. Eight distribution transformers. (E.S.B. 10608/54. Ten/9107.)*

9th July. 69 miles of 110 kV transmission lines and 70 miles of 66 kV line. (E.S.B. 10652/54. Ten/9100.)*

Iran.—TEHRAN.—13th May. Procurement Office. Copper cable, cable connection boxes and cable end boxes. (E.S.B. 10899/54. Ten/9121.)*

Iraq.—BAGDAD.—31st May. Directorate-General of Municipalities. Six 50 kVA transformers. (E.S.B. 10542/54. Ten/9081.)*

Kuwait.—14th June. Government of Kuwait. 11 kV woodpole overhead line equipment. (See this issue.)

London.—4th June. India Store Department. Single side band receivers for communication purposes. (See this issue.)

Newcastle-on-Tyne.—13th May. City Council. Electrical installation in the Sackville Road civil defence control centre. P. Parr, city engineer, Town Hall.

New Zealand.—WELLINGTON. 10th June. Stores Division, G.P.O. 700 retardation coils. (E.S.B. 10662/54. Ten/9099.)*

5th July. 20,000 insulator spindles. (E.S.B. 10502/54. Ten/9083.)*

Portsmouth. — 11th June. City Council. Electrically operated air conditioning and gas filtration plant, at the C.D. main control. City engineer, Council Chambers, 1, Clarence Parade.

Romford. — 15th May. Borough Council. Two electric street orderly trucks. Town clerk, Town Hall.

Salford.—22nd May. City Council. Refrigerator, washing machine and vacuum cleaner. (See this issue.)

South Africa.—JOHANNESBURG. 26th May. Stores Department, South African Railways. 5,000 unbreakable telegraph insulators and 26 concrete poles. (E.S.B. 10526/54. Ten/9076.)*

PRETORIA. — 3rd June. Union Tender and Supplies Board. Laboratory apparatus including ovens, ether extraction units and an electric furnace. (E.S.B. 10980/54. Ten/9139.)*

DURBAN.—11th June. City Council. Three 250 MVA switchboards. (E.S.B. 10983/54. Ten/9131.)*

Southend-on-Sea.—28th May. Corporation. Electrical installation in Westcliff High School for Boys. (See this issue.)

Sunderland.—21st May. Education Committee. Electrical installation at the Broadway Primary Junior School. Borough architect, Grange House, Stockton Road.

United States.—DENVER, COLORADO.—13th May. U.S. Bureau of Reclamation. Circuit breaker. (E.S.B. 10572/54. Ten/9087.)*

SEATTLE.—17th May. City Lighting Department. Paper insulated cable with lead sheath and neoprene jacket. (E.S.B. 10576/54. Ten/9092.)*

West Riding.—17th May. County Council. Rewiring at Conisborough Northcliffe Road Secondary School. (See this issue.)

ORDERS PLACED

Aylesbury.—Corporation. Electrical installations for 40 houses at Court Close, Stoke Road (£1,145).—W. S. Hearn.

Durham.—County Education Committee. Electrical installations in schools: Hartlepool Hart Road County (£752).—Gray Brothers. Hartlepool Prissick Endowed (£170).—B. French. Sherburn Hill County (£452).—Dougal & Railton. Barnard Castle Modern (£220).—James Paterson & Co. Boldon Colliery Modern (£849) and Shotley Bridge New County (£1,094).—Higginbottom & Sons. Windlestone Hall Residential (£5,814).—Doves (Darlington).

Littlehampton.—U.D.C. Town Planning, Housing and Buildings Committee. Electrical installations in 30 type "M" houses being erected on the Wickbourne state (£775).—Rice & Son.

Whickham (Durham). — U.D.C. Electrical wiring of 171 council houses.—T. W. Steanson (Gateshead).

Wisbech.—U.D.C. Street lighting on trunk road A.47.—Cohen Bros. (Electrical), Ltd.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Ashby.—New estate adjoining Tamworth Road (267 houses); Council's architect, Ashby, Leics.

Barnsley.—School, Athersley estate; Dyson Cawthorne & Coles, architects, Barnsley.

Barrow-in-Furness.—Home for 50 aged persons and houses (107), Abbotsmead estate; borough surveyor.

Beckenham.—Dwellings in 13 blocks on site adjoining Crystal Palace Park Road and Sydenham Avenue; James & Bywaters, architects, 5, Bloomsbury Street, London, W.C.1.

Bingley.—Weaving shed for S. Jerome & Sons, Ltd., Limefield Mills, Bingley; Jabez Whittingham & Sons, Ltd., Cross Flatts, Bingley.

Birmingham. — New church (All Saints') at Shard End; John P. Osborne & Son, architects, 95, Colmore Row, Birmingham, 3.

Bishop Auckland.—Infants' school, Woodhouse Close, and extensions to training school; county architect, Court Lane, Durham.

Blackburn. — Reconstruction of their premises at Quarry Street for J. & S. Leaver, Ltd.; W. Livesey & Sons, Ltd., Novia Scotia, Blackburn.

Bollington (Ches). — Houses (72), Henshall Road; U.D.C. surveyor, Wellington Road.

Brighton.—Factories at Hollingbury (Henry Clark & Sons, Ltd.) and East Moulscombe area, farm buildings, etc., Patcham Court Farm (£17,000), and seven-class school for St. Joseph's (R.C.) Church, Hollingbury; borough engineer and surveyor, 26–30, King's Road, Brighton, 1.

Flats (16), Albion Hill site; John W. Ridge, Ltd., 42, Portland Street, Brighton, 1.

Firemen's houses (8), in Roedean Road, Brighton; A. C. Jenkins, Ltd., Barn Garage, Ladies' Mile Road, Brighton, 6.

Cardiff.—Secondary school for girls, Llanrumney; L. C. Patterson, architect, 11, Cathedral Road.

Gosberton.—Adaptation of Gosberton

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

House as a special school (£32,050); county architect, County Offices, Boston.

Hartismere.—Houses (32), Yaxley; R.D.C. surveyor, Victoria Road Offices, Eye, Suffolk.

Hayes and Harlington.—Flats (60), Barnhill estate; U.D.C. surveyor, Town Hall, Hayes.

Hexham.—New Council Chamber for R.D.C. (£22,000); W. Dixon & Son, architects, 1, Collingwood Street, Newcastle-on-Tyne.

Holywell.—New dairy, outbuildings, etc., at Cefn Farm, for Flints C.C.; county surveyor, County Buildings, Mold.

Ilford.—Departmental store, Station Road and Station Approach; Higgins & Thomerson, architects, 76, Finsbury Pavement, London, E.C.2.

London.—BOW.—Flats (69), Devons estate; Stewart & Partners, Ltd., builders, 105, Baker Street, W.1.

CAMBERWELL. — County school (£450,000); Lyons & Israel, architects, 26, Seymour Street, W.1.

SOUTHWARK.—Flats (60), East Street and Manor Place; borough engineer.

Luton.—Factory, Union Street/Holly Street site; South Beds. Sheet Metal Co., Ltd., 1, Old Bedford Road.

Factory extensions, Villa Road; W. Wright & Son, Ltd., hat manufacturers, 1 & 3, Villa Road.

Manchester.—Extensions to works at Collyhurst Road, for Packing Materials Association, Ltd.; Frederick Hill, architect, 30, Crompton Street, Bury, Lancs.

Newburn(Northumberland).—Eleven old people's houses, Station Road site; U.D.C. surveyor.

Newcastle-on-Tyne.—Luxury flats (200), Montagu estate; Cussins, Ltd., builders, The Drive, Gosforth.

Newport (Mon).—Showrooms and offices; Ernest C. Jordan & Son, Ltd., Clarence Wharf, Rodney Road.

Houses (175), St. Julian's estate; borough architect.

Newton Aycliffe.—Proposed hotel near Neville Parade for J. W. Cameron & Co., Ltd.; E. M. Lawson, architect, Barras Buildings, Barras Bridge, Newcastle-on-Tyne.

Northampton.—Gymnasium at Boys' Grammar School (£14,879); Frederick Lack, Ltd., Northampton.

North Riding. — Proposed Eastfield No. 3 County Primary School at Scarborough; W. W. Atkinson, architect, 4, Raymond Bldgs., Grays Inn, London, W.C.1.

Oldbury.—Bungalows (36) and community centre, Pound Road; borough surveyor, Municipal Bank Chambers, Birmingham Street.

Oxford. — Showrooms and offices; Groom & Hornsby, car body specialists, 496d, Cowley Road.

Peterborough.—Houses (70), Walton estate; F. J. Smith, city engineer, Town Hall.

Reading.—Showrooms, Friar Street; C.C.A. Motors (Reading), Ltd., 576, Oxford Road.

Factory, Manor Farm estate; Sheet Metal Components (Reading), Ltd., 14, Cross Street.

Sale.—Houses (22), Northenden Road; H. Hankinson, architect, 3, The Downs, Altrincham.

Salford.—Extensions to works at Kersal Vale for Cussons Sons & Co., Ltd.; England & England, architects, 34, Birley Street, Blackburn.

Reinstatement of Cygnet Works, Browncross Street, for Sinclair Owen & Co., Ltd.; J. W. Beaumont & Sons, architects, Spring Gardens, Manchester.

Flats (102), Trinity clearance area; city engineer, Town Hall, 3.

Sanderstead (Croydon). — Houses (320), with shops, etc., on Morley's Field site, for Whitgift Governors; secretary to Whitgift Foundation, North End, Croydon.

Sheffield.—Extensions at King Edward VII Hospital for Regional Hospital Board; A. Bradbury & Sons, 344, Cemetery Road, Sheffield.

Skelton. — Houses (18), Brotton; U.D.C. surveyor, Council Offices, Skelton-in-Cleveland.

South Shields.—Additions to transport depot (£29,000); borough engineer.

Spalding. — Houses (56), Deeping Street; R.D.C. architect, Spalding, Lincs.

Stoke-on-Trent.—Extensions at North Staffs Technical College (£250,000); city architect.

Sunderland.—Flats (300), Lawrence Street clearance area; borough architect, Stockton Road.

Surbiton.—Laboratories, Cox Lane, Hook; Allied Bakeries, Ltd., 40, Berkeley Square, W.1.

Factory, Davis Road; H. A. Farmer & Co., Ltd., 73, The Bittoms, Kingston-on-Thames.

Sutton Coldfield.—New magistrates' courthouse in Lichfield Road (£60,740); T. Porter, borough surveyor, Council House.

Twickenham.—Proposal for erection of theatre, Deep Cross (£50,000); A. S. Knolles, borough surveyor, Municipal Offices.

Tynemouth. — Multi-storey flats (£750,000); Tasker & Child, architects, Trinity Buildings, New Bridge Street, Newcastle-on-Tyne.

Ulverston.—Houses (71), Croftlands Park site; U.D.C. surveyor, Theatre Street.

Wakefield.—School, Crigglestone, for West Riding C.C.; James Millar & Partners, Ltd., Newmillerdam, nr. Wakefield.

West Bromwich. — Comprehensive school, Churchfields; Richard Sheppard & Partners, architects, 16, Bedford Place, London, W.C.1.

West Horsley.—Houses (120), Rough House estate; J. W. Snape, architect, Millmead House, Guildford.

Wigston (Leics).—Houses (170), Lansdowne estate, South Wigston; U.D.C. architect, Wigston, Leics.

Willesden.—Office block; Wesley Builders, Ltd., 9, Wesley Avenue, London, N.W.10.

Wolverhampton.—Secondary modern school at Warstones East; A. G. Dawtry, town clerk.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 10th May

STAFFORD.—At the English Electric Co.'s Lecture Theatre, 7.15 p.m. I.E.E. North Staffs. Students' Section. Annual general meeting and film evening.

Tuesday, 11th May

BELFAST.—Presbyterian Hostel, Howard Street, 6.15 p.m. I.E.E. Northern Ireland Centre. Annual general meeting.

BIRMINGHAM.—Grand Hotel, 7 p.m. Institution of Works Managers, Birmingham Branch. Annual general meeting.

LIVERPOOL.—Electricity Board's Service Centre, Whitechapel, 6 p.m. I.E.S. Liverpool Centre. Annual general meeting, followed by a paper on "Traffic Signals," by T. P. Priest.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Measurements Section. "Measurement as a Factor in Understanding," by Dr. K. J. R. Wilkinson.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon. Address by Sir Norman Kipping.

STRATFORD-ON-AVON.—I.E.E. Rugby Students' Section. Theatre visit: "Romeo and Juliet."

Wednesday, 12th May

BELVEDERE.—I.E.E. London Students' Section. Visit to British Insulated Callender's Cables, Ltd., Erith Works (2.30 p.m.).

BIRMINGHAM.—James Watt Institute, 6.45 p.m. I.E.E. South Midland Students' Section. Annual general meeting, followed by films, arranged by G. S. Johns.

Wednesday, 12th May, to Saturday, 22nd May

PARIS. — Conférence Internationale des Grands Réseaux Electriques (C.I.G.R.E.).

Thursday, 13th May

BRISTOL.—Electricity House, 7 p.m. I.E.E. Bristol Students' Section. Annual general meeting.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Utilization Section. "Fuel Supplies of the Future," by E. F. Schumacher.

Friday, 14th May

LONDON.—1, Birdcage Walk, S.W.1, 5.30 p.m. Institution of Mechanical Engineers. "Rapid Starting Technique: Some Significant Tests at Poole Power Station," by J. S. Holland and A. F. Brittin.

BOOKS RECOMMENDED BY

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